SIEMENS TRAFFIC CONTROLS LIMITED
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SYSTEM/PROJECT/PRODUCT: T400 CONTROLLER

T400 CONTROLLER FACILITIES MANUAL

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(stcl-pub)

SAFETY WARNING

In the interests of health and safety, when using or servicing this equipment the following instructions must be noted and adhered to:

(i) Only skilled or instructed personnel with relevant technical knowledge and experience, who are also familiar with the safety procedures required when dealing with modern electrical/electronic equipment are to be allowed to use and/or work on the equipment. All work shall be performed in accordance with the Electricity at Work Regulations 1989.

(ii) Such personnel must take heed of all relevant notes, cautions and warnings in this Handbook, the Maintenance Handbook (667/HA/20200/000) and any other Document or Handbook associated with the equipment including, but not restricted to, the following:

(a) The equipment must be correctly connected to the specified incoming power supply.

(b) The equipment must be disconnected/isolated from the incoming power supply before removing any protective covers or working on any part from which the protective covers have been removed.

(c) This equipment contains a Lithium battery which must be disposed of in a safe manner. If in doubt as to the correct procedure refer to the Siemens instructions. CP No. 526.

(d) In the event of any person working elsewhere on the junction the Mains Supply to the controller must be switched off and the Master switch locked in the Off position using the Master Switch lock facility. (667/1/21386/000).

WARNING

Removal of the electricity board fuse or switching off the controller or the Manual Panel Signals On/Off switch does not guarantee isolation of the equipment.

ISSUE HISTORY

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Sheets marked # contain manual inserts.

Source Type*	Sheets	Source Reference
1	ALL	FACIL_8.DOC

* Source Types: 1=Paper, 2=VAX File, 3=Microfilm, 4=Caltext Disc
5=DECmate disc, 6=Paper Insert, 7=MAC Disc
8=LIFESPAN,
9=Other - MAC Drawings in MAC/TPVOL/T400 Folder.
- MCE 0141 sheets included.

Changes for issue 8:

- Headers and footers have been updated.
- 9.5.1 Priority of one Hurry Call over another. Text amended.

SUMMARY OF SECTIONS

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4. DEMANDS AND EXTENSIONS
5. CALL/CANCEL
6. HIGH SPEED VEHICLE DETECTION
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1. INTRODUCTION

This manual refers to the facilities available in the Type 400 Controller using firmware PB321 and PB322. For precise details of facilities supported by earlier versions of firmware see 667/SU/20200/000. This document is included in the General Handbook.

The controller conforms to the UK Department of Transport Specification MCE 0141, but also incorporates extra facilities.

The operation of the controller is phase oriented. Timings and demands are associated with phases and the control philosophy is designed to give right-of-way to phases in an optimum manner.

It is necessary to group phases into stages for Manual Control, operation in Urban Traffic Control Schemes and in Cableless Linking Schemes.

The grouping of phases into stages is conditioned by the traffic requirements and safety constraints.

Requests for ROW are received by the controller from:

(a) 'On-street' detection equipment and pedestrian pushbuttons
(b) the UTC computer
(c) the Cableless Linking Facility
(d) manual inputs
(e) special requests, e.g. hurry calls

The controller then orders the appearance of phases in accordance with the controller strategy, the current mode operative and the demand requests for ROW. The controller will always change stages cyclically.

1.1 GLOSSARY OF TERMS

Abbreviations

AC	Alternating Current
CET	Cable Earth Terminal
CLF	Cableless Linking Facility
CLU	Cableless Linking Unit
CMOS	Complementary Metal Oxide Silicon
CPU	Central Processing Unit
CRC	Cyclic Redundancy Code
CVT	Constant Voltage Transformer
DC	Direct Current
DFM	Detector Fault Monitor
ELCB	Earth Leakage Circuit Breaker
EMxxxxx	Controller Identity Number (Electromatic)
EPROM	Erasable Programmable Read Only Memory
FT	Fixed Time
FVP	Fixed Vehicle Period (Pelican mode)
GP	General Purpose
GR	"GR" Electronics Ltd.
I/G	Intergreen
I/O	Input/Output
I/P	Input
KOP	Kit of Parts
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LMU	Lamp Monitor Unit
LRT	Light Rail Transit
LRV	Light Rail Vehicle
LSTTL	Low Power Schottky Transistor Transistor Logic
mA	Milliamps
MC	Manual Control
MOVA	Microprocessor Optimised Vehicle Actuation
mS	MilliSeconds
MTC	Master Time Clock
MTCS	Master Time Clock System
NLT	No Left Turn
NRT	No Right Turn
OMCU	Outstation Monitor and Control Unit
OMU	Outstation Monitor Unit
OTU	Outstation Transmission Unit
PCB	Printed Circuit Board
PPM	Parts Per Million
PROM	Programmable Read Only Memory
PSU	Power Supply Unit
RAM	Random Access Memory
RCD	Residual Current Device
RFL	Reset Fault Log (Handset Command)

RLMU	Red Lamp Monitor Unit
RMS	Root Mean Square
ROW	Right Of Way
RTC	Real Time Clock
SA	Speed Assessment
SDE	Speed Discrimination Equipment
SIE	Supplementary Intergreen Extensions
ST	Self Tuning
STS	Site to Scale Drawing
SVD	Selective Vehicle Detector
SWG	Standard Wire Gauge
TCSU	Traffic Control Systems Unit
UTC	Urban Traffic Control
VA	Vehicle Actuated

1.2 RELATED DOCUMENTS

667/HH/20200/000
T400 CONTROLLER HANDSET COMMAND LIST

This handbook details the following:

(a) Data entry, Display and command formats

(b) The controller data which can be accessed via the handset and the handset commands necessary to access the items.

(c) Operational aspects of the intelligent terminal software which allows an EPSON HX20 to act as an intelligent terminal for use with a T400.

(d) Operational aspects of the intelligent terminal software which allows an IBM PC compatible Laptop Personal Computer to act as an intelligent terminal for use with a T400.

667/HD/20200/000
INTERSECTION CONFIGURATOR 003 USERS HANDBOOK

This handbook details the following:

(a) The hardware requirements for a configuring system (the configurator is Siemens software running on an IBM PC compatible computer).

(b) How to use the configuring system to enter data from the completed customer specification sheets into the computer and produce the programmed EPROMs required to configure the T400 controller.

This includes the writing of special conditioning and details on error messages which may be produced during the processing if data entered.

667/HA/20200/000
MAINTENANCE HANDBOOK FOR THE T400 CONTROLLER

This handbook details the following:

(a) Safety procedures when working on the T400 traffic controller and its ancillary equipment.

(b) The use of the handset/terminal for maintenance purpose.

(c) Routine maintenance/inspection procedures.

(d) Fault finding procedures.

(e) Procedures for replacing PCBs.

(f) Clarification of specific controller functions.

(g) PCB histories and retrospective modifications since initial design.

(h) The last section of the handbook contains a basic overview of the controller hardware at module level with a block diagram representation of the hardware.

2. STAGES

2.1 FACILITIES

There are up to 16 stages (0 to 15) available for use.

Stage 0 is normally used as a manual all-red facility. It may be used as a traffic stage.

Stage 1 normally is the start-up stage and must not be deleted.

Some stages may appear in some modes but not others. However, it may be possible to be in a stage not in the current mode if a change of mode occurs. If this happens then the stage will respond to current stage change conditions after all minimum greens for the phases in the stage have timed off.

2.2 ALLOCATION OF PHASES

The available phases are allocated to the stages in any combination subject to the method of control, the traffic requirements and safety considerations. Figure 21.2 and Figure 21.5 illustrate an example of allocating phases to stages.

2.3 STAGES ACTIVE

A stage is considered active when all fixed phases (see Sections 3.7.1 & 3.8) that are allocated to the stage are at green and all phases (fixed or non-fixed) that are not allocated to the stage are at red.

A stage is considered to be terminating when:

The first phase which has had ROW (i.e. been at green) during the stage, loses right of way.

2.4 INTERSTAGE PERIOD

The interstage period is the time between one stage terminating and another stage becoming active.

2.5 STAGE CHANGE ALGORITHM

In all modes the controller monitors the following all demands (for both phases and stages), extensions and maximum green timers every 200ms. These are monitored in order to check to see if it is possible to move to a new stage, and serve new demands.

In order to select the next stage (SUGGESTED STAGE) the controller goes through the following decision-making process.

Firstly, the controller sets the “suggested stage” as the current stage and the number of new “phases & stages to get right of way” to zero ‘0’.

These two items will then be updated as the controller goes though its decision-making process.

The following process is performed for each stage in cyclic order starting at current stage +1.

1. Are any of the phases in the stage or the stage itself, prevented and/or deleted?

   If NO, proceed to next step.

   If YES, (prevented and/or deleted) try next stage in cyclic order (starting at step 1).

2. Are there demands for phases in this stage or for the stage itself.

   If YES, proceed to next step.

   If NO, (i.e. phases/stage not demanded) try next stage in cyclic order (starting at step 1).

3. Can the current stage be terminated?
   i.e. will all phases which have extensions and for which the maximum green timer has not expired keep right of way in this stage (if selected as the “Suggested Stage”.)

   If YES, proceed to next step.

   If NO, add the demanded phases in this stage (or the stage itself if stage is demanded) to “Phases & Stages to Get right of way” (for checking later). Then try next stage in cyclic order (starting at Step 1).

4. Will all demanded phases which appear in previously checked stages and any specifically demanded stages previously checked (i.e. “Phases & Stages to Get right of way”) get right of way, be serviced by this stage?

   (N.B. Obviously if a previously checked stage is itself specifically demanded, no other stage can satisfy the demand and the answer to above question will be NO. Stage demands are normally only inserted from special conditioning or Modes of operation where specific stages are requested, i.e. CLF, UTC, Hurry Call, Fixed Time, Manual or Manual Step-On.)

   If YES, proceed to next step.

If NO, add the demand phases in this stage (or the stage itself if stage is demanded) to "Phases & stages to Get right of way". Then try next stage in cyclic order (starting at Step 1).

5. Will more demanded phases be serviced by this stage than in previously "Suggested Stage"?

   If YES, set "Suggested Stage" equal to this stage.

   If NO, add the demanded phases in this stage (or the stage itself if stage is demanded) to "Phases & Stages to Get right of way". Then try next stage in cyclic order (starting at Step 1).

   At the end of the decision-making process the "Suggested Stage" will either be a new stage other than the current stage, or it will have remained as the current stage.

   If the suggested stage is other than the current stage, the controller then checks the "Stage movement restriction" table appropriate to the mode, to see if it can make the move, see below:

   If the move from the current stage to the "Suggested Stage" is prohibited, the controller will stay in the current stage until the decision-making process comes up with a different "Suggested Stage" to move to.

   If the move from the current stage to "Suggested Stage" is an Ignore move, the controller will immediately return to the decision-making process, it will remove from the equation the demanded phases which would have been served by the previously "Suggested Stage" (so that process does not come up with same "Suggested Stage" again), and then it will start again searching for a stage to move to.

   If the move from the current stage to the "Suggested Stage" has an alternative stage move specified, the controller will move to the alternative stage and then restart the decision-making process.

   If the move from the current stage to the "Suggested Stage" is unrestricted, the controller will move to the "Suggested Stage" and then restart the decision-making process.

2.5.1 Effects of Modes other than V.A. on Stage Change Algorithm

In V.A. mode, the stage change algorithm is allowed to suggest a stage based on the influences current at the time without any manipulating of those influences.

However, in other modes, namely CLF, UTC, Fixed Time, Priority, Part-Time, Manual and Manual Step-On, the modes influence the outcome of the stage change algorithm. This can be done by:

a) applying stage/phase prevents,
b) masking out phase demand,
c) inserting stage demands,
d) masking out extensions, i.e. causing them to be ignored,
e) Suspending maximum green times.

Thus for above-mentioned modes, specific stages may be requested, and the controller forced to serve them when required.

2.5.2 Usage of Stage Movement Restriction Tables

The controller will always use the stage movement restriction table, applicable to the mode in which it is operating when it initiates the stage change.

EXAMPLE

If a priority demand invokes a stage change, the controller will be in priority mode due to the priority demand and will use the stage change restrictions table applicable to priority mode.

However, if the controller has already decided to make a stage change in the VA mode and a priority demand is received, the controller will continue to make the VA move although the mode will have changed. The controller will then only use the stage movement restriction table applicable to priority mode if it makes any subsequent moves whilst still in priority mode.

2.6 PARALLEL STAGE STREAMING

2.6.1 General

Parallel Stage Streaming will provide independant control of up to 4 separate intersections, later referred to as Streams, from one controller, i.e. the four intersections may be considered as being controlled by separate controllers with the exception of working in Manual mode, Part Time mode (see section 2.6.3), linked fixed time and manual step on (see section 2.6.4).

This facility would normally be used if there are to be no cross-stream Phase Conflicts. However, cross-stream Phase Conflicts and cross-stream Linking can be covered by using either cross-stream Phase Intergreen or Special Conditioning Software.

2.6.2 Stage Streams

The controller will support up to 4 streams (numbered 0 to 3). Each stream may contain any number of stages but no stage may appear in more than one stream and the total number of stages for all streams must not exceed 16.

All stages contained within a stream must be numbered consecutively starting at Stage 0 for Stream 0.

If a stream requires an all red condition then a separate all red stage must be provided for that stream. No phase may appear in more than one stream.

2.6.3 Mode Selection

Each stream will independently run the highest priority mode for which a request exists, except in the case of Manual and Part Time modes. (See also section 9.12).

Manual mode will be operated on all streams simultaneously and will be operative only if Manual has been selected from the Manual Panel and no higher priority mode is running on any stream. If Manual Mode has been selected and one or more streams runs a higher priority mode, then Manual Mode will not be operational on any stream. Any stream not running a higher than Manual priority mode will run a lower than Manual priority mode.

Part Time Mode will always be placed in the top priority position and, when requested, will be implemented on all streams simultaneously.

Each mode, with the exception of Manual and Part Time, may be configured so that it is disabled on an individual stream. Manual and Part Time may be disabled but would be disabled on all streams simultaneously. The modes may be disabled as a standard configuration item but may also be enabled or disabled on a per stream basis via Special Conditioning.

Forms IX & IXa allow for modes to be disabled permanently, and operation of certain mode select buttons to be made inoperative permanently.

However, some situations do not require the above-mentioned items deleted on a permanent basis, rather only under special conditions.

For example, on a two stream controller, if VA was not required on Stream 1 but was required on Stream 2, the mode could be permanently disabled for Stream 1. However, the selected VA position of the mode select buttons could not be made permanently non-operative, and similarly neither could the ‘Selected Fixed Time/VA’ mode on form IXa. As Selected Fixed Time will be required on Stream 1 (where VA is not required) and both selected VA and Selected Fixed Time may be required on Stream 2. In this instance, Special Conditioning is required to disable the ‘Selected Fixed Time/VA’ mode on Stream 1 when the VA mode select button is pressed (see also Section 4.4.4).

2.6.4 Mode Operation

(See also section 9.)

2.6.4(a) Fixed Time

Each stream will have its own fixed sequence of stages and will move around it independently of the other streams. Alternatively the streams can be linked, allowing groups of stages to run together, i.e. Linked Fixed Time.

2.6.4(b) VA

Each stream will move around its own stages according to its own on street demands and extensions independent of any other streams.

2.6.4(c) CLF

The controller has up to 8 plans. Each plan can run up to 16 groups. Each group when active can operate up to 4 influences simultaneously,1 influence for each stream. There is an influence set for each plan where an influence set consists of 4 influences for each of the 16 groups (Combinations A, B, C and D). In general, Influence Set Combination 'A' would be used for Stream 0, Influence Set Combination 'B' for Stream 1, etc.

In this way it is possible on introduction of a group to operate different influences at the same time on difference streams.

If it is required that, during a given group timing, a stream is not required to change influence, then this stream's influence should be set to Group Influence number 7 followed by the related stage number, i.e. the number of any stage contained within the stream upon which the influence acts. (See sub-section 9.9.7, Figure 9.7).

Only one plan can be in operation on the controller at once while in CLF. CLF can run on all streams at once or on some streams with the remainder running higher priority modes. If CLF is disabled on a stream then that stream will run the next lower priority mode.

For further description of CLF mode see section 9.9.

2.6.4(d) Manual Control

The Manual Stage Buttons are programmed so that each of the 7 buttons can select:

a) a combination of stages, one from each stream, that will run simultaneously.

b) one stage from any one stream

The all red button can be programmed to select:

a) an all red condition on all streams

b) an all red condition on any one stream - it would normally be necessary to programme other buttons for all red conditions on any other streams.

The Awaiting New Command lamp will only illuminate when all phase minimums on all streams have expired and consequently allow further moves to be made using the Manual Buttons.

A change is accepted as valid even if only one of the stage streams changes.

The Manual Panel indicators illuminate when the stage that is configured to the corresponding button is active.

For parallel Stage Streams the buttons can be configured to call combinations of stages in the individual streams and the LEDs illuminate when the combinations configured to the corresponding buttons are active. The indicators illuminate in VA and fixed time mode as well as manual mode and irrespective of whether the handset is plugged in.

Manual Step-On:-

If fitted, the Controller will step on to the next stage, or combination of stages, on the operation of a pushbutton. See also section 9.7.

2.6.4(e) Hurry Call

2 Hurry Call units are available, numbered 0 and 1, and they may be allocated to any stage on any stream.

If they are both allocated to different stages but in the same stream, they will be actioned on the basis of Hurry Call 0 being of higher priority than Hurry Call 1.

However, if they are allocated to different stages but in different streams, they can both be actioned simultaneously, neither having precedence over the other or affecting each other in any way.

2.6.4(f) Priority and Emergency Vehicle

Each stream will move around its own stages according to its own Priority or Emergency Vehicle demands and extensions independent of any other streams.

2.6.4(g) UTC

UTC mode can be active on any or all of the streams. If there are force bits present on any stream then the UTC active lamp will illuminate on the manual panel. Each stream can respond to its force bits independently of the other streams. If, however, it is required to have Master-Master UTC Linking, i.e. for UTC mode to operate on any stream, force bits are required to be present for all streams, then the UTC mode may be disabled on the relevant streams by Special Conditioning until the correct force bits are available.

2.6.4(h) Part Time (see also Para. 2.6.3)

The Part Time switch off mode, when requested, will apply simultaneously to all streams.

Each stream will then move immediately to its individual switch off stage subject to any delays caused by minimum greens or intergreens timing off and also subject to any stage movement restrictions.

When all streams have reached their switch-off stages and all minimum greens have expired then all signals will be extinguished.

The Part Time switch off stage for each stream is specified in configuration.

2.6.4(i) Start Up

The start-up stage for each stream is configurable. This determines the stages that the controller starts up in when powering up, when coming out of Part Time, or after the signals have been switched off from Special Conditioning (using the method that implements start-up).

2.6.5 Window Timers

(See also section 3.7.4)

Provision has been made within the software to provide 4 separate window timers, one for each stream. This is necessary because up to 4 stages may be running simultaneously, each demanding a different window time. Each window timer will run the window time related to the stage within its associated stream. This is associated with type 3 phases.

2.6.6 Extend all Red (Hold Intergreen)

(See also section 7)

There is an extend all red Facility available on each stream. There is a separate All Red Extension time and All Red Maximum time for each stream. If the extend all red input is active on the specified stage to stage movement, then when the first phase in the stream that is about to go to green reaches the start of its red-green transition period, the intergreen and delay times concerned with the intergreen are held until the All Red extension period terminates or the All Red Maximum time is reached. (See also section 19.2).

Each stream's all red extension time may be accessed using the handset command:

REX followed by the stream number (e.g. REX1)

Each stream's all red maximum time may be accessed using the handset command:

RMX followed by the stream number (e.g. RMX2)

2.6.7 LMU Supplementary Intergreen Extensions

There is an LMU supplementary intergreen extension facility available for each stream. If an LMU indicates one red lamp fail (see Section 19.2) then the all red period of the

intergreens on the configured stage to stage movements will be held until the supplementary extension timer expires. The extension period is measured from the stage change point. Each streams extension can be accessed by using the handset command:

SIE followed by the stream number (e.g. SIE2). Data is in the range 0 to 31.8 secs. in 0.2 second steps.

2.6.8 LMU Maximum All Red

There is an LMU maximum all red facility available for each stream. If an LMU indicates a second red lamp failure pending (see section 19.2) then the all red period of the intergreens on the configured stage to stage movements will be held until the LMU maximum all red timer expires. The maximum period is measured from the stage change point. Each stream's maximum can be accessed by using the handset command:

LMX followed by the stream number (e.g. LMX 0) Data is in the range 0 to 255 secs. in 1 second steps.

2.6.9 SDE/SA

If a phase with SDE/SA is requesting extra clearance and so increasing the time in its associated intergreen timer, it is possible to specify at configuration which delay timers (for phases gaining ROW) are to also be increased. In this way it is possible to specify delay timers just for the phases appearing in a particular stream, whilst not increasing those in other streams.

2.6.10 Arterial Reversion

There is an Arterial Reversion facility for each stream. If there is no demand or extension present for any phase in the stream, and no demand for any stage in the stream, then an Arterial demand for a phase or stage in the stream will be inserted, if specified in configuration.

3. PHASES

3.1 FACILITIES

There are up to 16 phases (A to P) available for use as any of the following types of phase:

- Traffic
- Pedestrian
- Green arrow, filter or indicative
- LRT vehicle
- Dummy
- Switched sign.

Note: Pelican, pedestrian and vehicle phases and the pelican audio indication are described in section 17.

Traffic, pedestrian and green arrow phases are considered as real phases and require phase hardware as well as phase software.

Dummy phases require only phase software. As no phase hardware is required the dummy phases are allocated after the real phases.

Switched sign phases do not require phase software. They require the software necessary for switching them on and off and phase hardware.

It is possible to use phase software for a dummy phase and phase hardware for a switched sign phase.

(N.B. For more details on specific lamp sequences for particular countries of the world, refer to Section 14.)

3.2 TYPES OF PHASES

3.2.1 Traffic Phase

A traffic phase controls vehicle movements via a 3-aspect signal comprising red, amber and green. The green aspect may be a left turn or a right turn or straight ahead green arrow as required by the method of control.

The standard signal sequence is as follows:

RED - at no ROW
RED/AMBER - changing to ROW
GREEN - at ROW
AMBER - changing to no ROW

The red/amber period is normally 2 seconds and the amber period is normally 3 seconds.

Alternative signal sequences, e.g. RED-GREEN-AMBER-RED, may be obtained if required.

In the example in Figure 21.2 and Figure 21.3, phases A,B,E and F are traffic phases.

3.2.2 Pedestrian Phase

A pedestrian phase controls pedestrian movements via a 2-aspect signal comprising red and green man plus a WAIT indicator.

The standard signal sequence is as follows:

RED MAN - at no ROW
GREEN MAN - at ROW
BLACKOUT - changing to no ROW

Alternative signal sequences, e.g. RED MAN - GREEN MAN - AMBER MAN, or RED MAN - GREEN MAN - FLASHING GREEN MAN, or others may be obtained if required.

The WAIT indicator uses the amber aspect drive (if not used for anything else, see section 3.2.53.2.5(b)) and is illuminated when a demand is inserted for the pedestrian phase from a pedestrian push-button unit. It will remain illuminated until the pedestrian phase gains ROW when it will be extinguished. During the green man period demands for the pedestrian phase are disregarded but they will be accepted during the blackout period and thus illuminate the WAIT indicator.

A pedestrian phase is not extendible. However, if it appears in the same stage as a traffic or green arrow phase and they are extended, the pedestrian phase will be held at green.

In the example in Figure 21.2 and Figure 21.3, phase G is a pedestrian phase.

3.2.2(a) MCE0141 Audible Indication (Low Voltage)

It is possible to have audible indication when a pedestrian phase is at green, if required. This may be sounded for the entire period of green or just for a minimum period.

The audible units fit into the pedestrian push-button units. Up to two may be fitted to give an alternative of loud for daytime use and soft for night time, switched by the master time clock.

For equipment required see section 18.

Note: It is a requirement of the Department of Transport that the audible indication facility must be accompanied by a Red Lamp Monitoring facility. (See sub-section 19.2).

3.2.2(b) MCE0141 Audible Indication 2 (High Voltage)

The audible signals are driven direct from the aspect supply to the pedestrian red and green signals via relay contacts. An I/O port will be used to drive a relay to disconnect the red and green feeds to the audible signal when it is not required. Eight pedestrian signals will be controlled usually by timeswitch control.

8 relays are provided and driven from an output port bit to switch the above feeds on and off.

The handset command "DET" for the specific output port/bit can be used to switch this facility permanently ON, OFF, or allow it to follow the output state as dictated by the controller logic.

3.2.2(c) LRT Phase (Option for Export)

This is a pedestrian phase used to control Light Rail Transit vehicles via a 2-aspect signal stop and proceed. The proceed may be ahead, left turn or right turn arrow, as required by the method of control.

(N.B. If two different movements are required for proceed, e.g. ahead or left turn, then two phases must be used.)

The standard signal sequence is as follows:

stop	-	at no ROW
proceed	-	at ROW (treated as a green for conflict purposes)
flashing proceed	-	leaving right of way (changing to No right of way)

3.2.3 Green Arrow Phase

A green arrow phase controls vehicle movements via a single aspect green arrow.

There are two types of green arrow:

- Filter
- Indicative

3.2.3(a) Filter Green Arrow

A filter green arrow may be used to allow filter traffic to gain ROW in advance of the main movement. It is illuminated during the stage or stages preceding the stage in which its associated phase appears.

It will remain illuminated during the interstage period, normally until its associated phase gains ROW, when it will be extinguished.

Alternatively, it can remain illuminated during the green of its associated phase and extinguish at the commencement of the amber leaving.

For safety reasons, and in the U.K. to meet DTp Specifications, a filter green arrow must always be followed by the green of its associated phase. To achieve this, a demand dependent filter green arrow must also demand its associated phase. A filter

green arrow that appears unconditionally must always be followed by its associated phase by means of stage movement restrictions (see section 10). Alternative methods of control can be provided to meet other specifications.

During Manual Mode the appearance of the filter green arrow during its associated stage(s) is configurable, i.e. ON, OFF or Demand Dependant.

In the example in Figure 21.2 and Figure 21.3, phase D is a filter green arrow associated with Phase E. If Phase D appears during stage 2 then the demand for Phase E will ensure that Stage 3 follows. If Phase D does not appear in Stage 2 then Stage 3 needn't necessarily follow.

3.2.3(b) Indicative Green Arrow

An indicative green arrow may be used when an early cut off facility is required to allow turning traffic. The green arrow will be illuminated after a pre-determined intergreen period from the conflicting main movement. This is normally set at 3 seconds so that the green arrow appears at the start of the conflicting red. The green arrow will remain illuminated throughout the green of its associated phase and will be extinguished at the commencement of the amber leaving.

If required, the demand for the indicative green arrow will only mature if a demand exists for an opposing or other specified phase.

It may be required to use a Call/Cancel facility with an indicative green arrow (see section 5).

To meet Department of Transport specifications, an indicative green arrow must always be followed by the amber leaving of its associated phase. If a direct move back to the main movement is required the stage change must go via an All-Red Stage (see sub-section 7.1).

Alternative methods of control can be provided to meet other specifications.

In the example in Figure 21.2 and Figure 21.3, phase C is an indicative green arrow associated with Phase B. Phase C will be illuminated after an inter-green period from Phase A has timed off.

3.2.4 Dummy Phase

A dummy phase may be used in situations where timings or detector conditioning have to be associated with a traffic movement that is not uniquely signalled. The dummy phase provides suitable time periods or conditions stage changes even though no signal aspects are associated with the phase.

3.2.5 Switched Sign Phase

A switched sign phase is a phase that is not allocated to a stage but is illuminated and extinguished by the timeclock or when specific conditions occur.

The normal functions of a switched sign phase are as follows:

3.2.5(a) Secret Regulatory Signs

Secret regulatory signs, e.g. NRT, NLT, etc. are illuminated and extinguished at a certain time of day when a specified associated phase loses ROW.

3.2.5(b) WAIT Indicator for 3-aspect Phases (Export Only)

When a pedestrian phase has a WAIT indicator the power to it is normally supplied by the amber drive. If a pedestrian phase has 3-aspects (i.e. Red Man-Amber Man-Green Man), or if a traffic phase requires a WAIT indicator, then this drive is not available.

A switched sign phase is then used. It is illuminated when the phase is not active and a demand for it is present. It is extinguished when the pedestrian phase gains ROW.

3.3 CONFLICTING PHASES

Real phases which cannot appear together for safety reasons are considered to be conflicting and as such must have intergreen times between them.

Phases which conflict but may never make a phase to phase transition due to stage movement restrictions must also have intergreen times between them. This is to cover the possibility of intergreen and minimum green times of phases in intermediate stages being set low enough on the handset to allow the phase to phase transition to take place. If an intergreen time is not specified by the Customer then it will be set to 5 seconds.

Phases which do not conflict and never appear together are considered to be non-conflicting phases and as such will not have an intergreen time.

Works specification form IV is used to determine conflicting phases, i.e. the ones with times are conflicting.

3.4 OPPOSING PHASES

Demands for opposing phases are used to start phase maximum green timers.

Normally, phases which conflict also oppose. Dummy phases that would conflict if they were real phases also oppose.

Phases which do not conflict but do not always appear together may be programmed to oppose in order to start one or the others maximum green timers.

When a phase is active any latched demands for it are disregarded. Therefore, when opposing phases appear at the same instant, they will not start each others maximum green timers.

All phases will normally be set to oppose each other, unless works specifications form III is completed to specify which phases oppose which phases.

3.5 TIMING PERIODS

Each phase has its own minimum green timer, green extension timer, maximum green timer and pedestrian blackout timer.

Each phase to phase transition has its own intergreen timer.

The following timing periods are set in the PROM at the time of configuration but may be changed via the handset, using the commands in brackets.

3.5.1 Minimum Green (MIN)

When a phase gains ROW a minimum green period commences to time. For safety reasons the phase cannot lose ROW until the minimum green has timed off, whatever mode of control is operative. The minimum green cannot be terminated prematurely.

Stage changes will not take place until the last minimum green for phases in that stage has timed off unless the associated phases run in the new stage.

The timing range is 0 to 255 seconds in 1 second steps.

3.5.2 Green Extension (EXT)

When a vehicle actuated phase (i.e. traffic, green arrow or dummy phase) is at green, it is possible to extend it past the minimum green period by means of green extensions, up to a maximum green period.

The occupation of an extension loop will generate a green extension for its associated phase. The green extension will continue while the loop is occupied.

When the extension loop is cleared, the green extension will continue for a fixed period - the extension time.

It is possible to program the controller so that extensions for a phase are lifted during any stage that the phase appears in.

The phase cannot be terminated whilst the green extension is active unless it is legitimately overridden (e.g. maximum green timer terminating or under influence of UTC or CLF).

If no vehicles are detected for a period longer than the extension time then the phase will ‘gap change’ if there is an opposing demand.

The timing range is 0 to 31.8 seconds in 0.2 second steps.

3.5.3 Maximum Green (MAX,MBX,MCX,MDX)

A maximum green timer is provided for each vehicle actuated phase and commences to time upon receipt of a demand for any opposing phase. If the opposing demand is present when the phase gains ROW then the maximum green period will commence to time off immediately.

Stage changes will not take place until the last maximum green timer for phases in that stage have timed off, unless the associated phase runs in the new stage.

It is possible to program the controller so that a specified phase has a pre-timed maximum green. This means that the maximum green timer will always run whenever the phase is active, regardless of opposing demands.

A pre-timed maximum green is achieved by allocating a dummy phase to oppose the specified phase. The dummy phase is not allocated to any stage and never appears. When the specified phase gains ROW, an unlatched demand is inserted for the dummy phase. This starts the maximum green timer of the specified phase. When the specified phase loses ROW, the unlatched demand for the dummy phase is cleared.

The maximum green timer will only be effective during VA, Bus Priority and Emergency Vehicle modes. During CLF mode it will be ignored. During UTC mode, if it is not to be considered for special requirements, it is possible to configure it to be held reset.

Four sets of maximum green timings are available. These are switched in and out as required by the master time clock (see section 11).

The timing range is 0 to 255 seconds in 1 second steps.

3.5.4 Pedestrian Blackout/Flashing Green (PBT)

When a pedestrian phase terminates, the green man is followed by a preset blackout period for U.K. (or flashing green for some countries abroad) which in turn is followed by the red man. The blackout period is considered as part of the intergreen, i.e. the two timers will run in parallel.

The timing range is 0 to 255 seconds in 1 second steps.

If no blackout/flashing green is required the timer should be set to 0 seconds.

Figure 21.3 illustrates the allocation of the above timing periods to phases.

3.5.5 Intergreen (IGN)

The intergreen period is a safety period between one phase losing ROW and another phase gaining ROW. Only conflicting phase to phase transitions can have individual intergreen timing values.

No intergreen period is reduced below its value during phase changes. In the event of different intergreen values to phases gaining ROW, the longest intergreen will be effective.

If phases conflict, but due to stage movement restrictions, the phase to phase transition never takes place, the intergreen value should be set the same as the intergreen limiting value for safety reasons. The I/G's D-A and C-A in Figure 21.4 are examples of this.

The timing range is 0 to 199 seconds in 1 second steps.

Figure 21.4 illustrates the allocation of intergreen timings for conflicting phases for the intersection in Figure 21.2 and Figure 21.3. As an example, intergreens A-E and B-E are 5 seconds and intergreen C-E is 7 seconds. This would have the effect of a 5 second intergreen to Phase E on a stage change 1-3, but 7 seconds on a stage change 2-3.

3.5.6 Starting Intergreen (IGS)

The starting intergreen period is a safety period in Start-Up Mode before any phases gain ROW, (see section 9.1).

3.5.7 Conditioning Timers (PIR)

Up to 32 conditioning timers (0 to 31) are available for use as auxiliary timers using PB321, and up to 64 conditioning timers (0 to 63) are available for use as auxiliary timers using PB322 issue 3 and later.

The uses of the conditioning timers include the following:

(a) Delay, Lift Inhibit and Override Timers for use with a Pelican Link facility.

(b) Holding a stage for a specified fixed period when no phases gain ROW. Normally dummy phases are used for this purpose, but this method may be used if no dummy phases are available.

(c) Timing long periods - can be achieved by running the same timer several times, e.g. to time 20 minutes, give the timer a value of 120 secs. and run it 10 times.

(d) Switched window timers.

(e) Limit Green watchdog timer.

(f) Hurry call watchdog timer.

(g) Intergreens extended by curtailed extensions.

(h) Special facility, if applicable.

(i) Fixed Period during Manual Step-On. (Export only).

The timing range is 0 to 255 seconds in 1 second steps.

3.5.8 Limit Green Watchdog (Facility constructed in Special Conditioning for Export Only).

In all modes except Hurry Call, Vehicle Actuated and Manual Control, the maximum duration of each stage green can be governed by a limit green watchdog time. One limit green watchdog timer (a Special Conditioning timer) is provided, which is applied to each stage in turn.

The stage limit green watchdog timer commences timing when the stage green is reached and is reset on a plan change, a mode change and when the stage terminates.

If the limit green override code is sent from the ATC computer during computer stage control mode, the limit green watchdog timer is held reset.

In the event of a limit green watchdog timer timing out before its associated phase green has terminated, the controller will then revert to the next highest priority mode configured for which a request exists and the fault will be logged. If the current mode at the time of failure is fixed time mode, the controller switches off the power to the lamps.

3.6 HANDSET RANGE LIMITS AND THRESHOLD VALUES

The following handset commands have configurable minimum and maximum range limits on the value of data which can be entered via the handset. There is only one minimum limit and one maximum limit for each of the commands (with the exception of minimum greens and intergreens which are described separately).

Minimum Green	MIN
Green Extensions	EXT
Maximum Green	MAX
Phase Intergreen	IGN
Phase Delays	DPG
Pedestrian Flash Time	PBT
Starting Intergreen Period	SIG
Hurry Call Delay	DHC
Hurry Call Hold	HHC
Hurry Call Prevent	PHC
Group Time	PLT
Offset Time	OFF
DFM Time	DFD
Priority First Delay Timer	PFD
Priority Second Delay Timer	PSD

3.6.1 Minimum Green Thresholds

Minimum Green times have range limits for each phase (i.e. each phase has an upper and lower minimum green time associated with it.)

3.6.2 Intergreen Thresholds

Intergreen times have a common maximum limit but there is an individual lower limit associated with each intergreen time.

3.7 CONDITIONS OF APPEARANCE

If more than one phase is allocated to a stage, it may be required to make the appearance of some of them conditional so that they will only appear if demanded. The condition will apply in all the stages to which the phase is allocated.

There are four different types of appearance. The normal one is Appearance Type 0.

3.7.1 Appearance Type 0

This is the normal type of condition with the phase always appearing whenever its associated stage runs. If more than one Type 0 phase is allocated to the stage they will all appear regardless of which phase was demanded. In the intersection illustrated in Figure 21.2 and Figure 21.3, Phases A and B will always appear whenever Stage 1 runs, Phases B and C when Stage 2 runs, Phases E and F when Stage 3 runs and Phases F and H when Stage 4 runs.

3.7.2 Appearance Type 1

The phase will only appear whenever its associated stage runs if a demand for it is inserted before the start of the interstage. If the demand is inserted after this point it will be stored and can be configured using a special software algorithm either:

a) to be ignored if there are other demands present and not influence the next stage change and then to be considered for subsequent stage changes; but if there are no other demands it will cause a stage change to a stage which honours the demands.

b) Not to be ignored and influence the next stage change.

The algorithm may be accessed using the handset command PMV.

The normal use for this type of condition is for a pedestrian phase as illustrated in Figure 21.2 & Figure 21.3 with Phase G. If, for example, Phase G hadn't appeared in Stage 1 and was subsequently demanded, it would then appear in Stage 2 when it runs, although under normal circumstances the demand for Phase G wouldn't cause the stage change.

3.7.3 Appearance Type 2

The phase will only appear whenever its associated stage runs if demanded, although there is no limit point for when the demand may be inserted. If the demand is inserted before the stage runs then the phase will appear at the start of the stage. If the demand is inserted during the stage then the phase will appear immediately. The appearance of the phase in both cases will be subject to any relevant intergreen periods timing off.

When the phase appears its timing periods will be considered for the stage duration. Therefore, if the phase appears during the stage its minimum green period, and possibly maximum green period, may affect the termination of the stage. Therefore this type should only be used if essential. Appearance Type 3 should be used unless the phase is a filter green arrow.

The normal use for this type of condition is a filter green arrow phase as illustrated in Figure 21.2 & Figure 21.3 with Phase D. The minimum green has been set to 0 seconds to prevent the green arrow appearance affecting the termination of the stage.

A demand for the filter green arrow should not be latched to ensure that a filter green arrow demand does not exist without an associated main green demand.

The green arrow active should insert a demand for the main green phase.

3.7.4 Appearance Type 3

This is as Appearance Type 2 but the appearance of the phase after the stage has commenced is inhibited after the expiry of a window period. The window period is started by an opposing demand, except in UTC mode when it commences at the start of the stage. Any demand inserted after this will be stored and can be configured using a special software algorithm to affect the subsequent stage changes in different ways (see section 3.7.2).

The window period is normally the difference between the longest maximum green period of the other phases in the stage and the minimum green period of the conditional phase. This means that the phase will not appear if there is not enough time left for its minimum green to run and so will not affect the stage termination.

If the alternative maximum green facility is used, this may affect the required window time. There are two ways to overcome this. One is to have a compromise window time which will suit all of the alternative maximum green periods. The other is to switch the window times along with the alternative maximum green times.

There are two methods to achieve switched window times:

(i) Alternate stages with the alternative window times are introduced and deleted by the master time clock at the same time as the alternative maximum green periods.

(ii) The conditional phase is programmed as an Appearance Type 2 and conditioning timers are used as window timers to inhibit the appearance of the phase. The conditioning timers are introduced and deleted by the master time clock at the same time as the alternative maximum green periods.

The timing range of the window period is 0 to 255 seconds in 1 second steps. The timers are individual to stages and Figure 21.5 illustrates the allocation point.

The programmed value of the window timer may be changed via the handset using the PWN command.

With Appearance Types 1, 2 and 3, the intergreen periods following the stage termination may be affected by the appearance or non-appearance of the phases.

The condition of appearance of phases which are deleted by the master time clock will only be effective during the period of non-deletion. (See section 11).

3.7.5 Window Timers Parallel Stage Streaming Facilities

(See also section 3.7.4)

Provision has been made within the software to provide 4 separate window timers, one for each stream. This is necessary because up to 4 stages may be running simultaneously, each demanding a different window time. Each window timer will run the window time related to the stage within its associated stream. This is associated with type 3 phase.

3.8 FIXED PHASES

A fixed phase is a phase (real or dummy) that has a condition of appearance Type 0 and is not deleted by timeswitch at any time.

(a) At least one fixed phase must be allocated to each stage (with the exception of the manual all-red facility).
(b) On stage changes at least one fixed phase must gain ROW.

3.9 NON-FIXED PHASES

A non-fixed phase is a phase (real or dummy) that has a condition of appearance Type 1, 2 or 3, whether it is deleted at any time or not, or a phase that has a condition of appearance Type 0 and is deleted at some time.

During Manual Mode the appearance of a non-fixed phase during its associated stage(s) may be configured to:
a) never appear
b) always appear (subject to any delete phase conditions)

c) be demand dependant

3.10 CONDITIONS OF TERMINATION

3.10.1 Termination Type 0

The phase terminates at the end of its associated stage. If the phase appears in consecutive stages then it will remain at green throughout the interstage period.

This is the normal type of phase termination. (See Figure 21.2 and Figure 21.3).

3.10.2 Termination Type 1

The phase terminates when a specified associated phase gains ROW. The associated phase must be a fixed phase.

The normal use for this type of phase is a filter green arrow as illustrated with Phase D in Figure 21.2 & Figure 21.3.

3.10.3 Termination Type 2

The phase terminates when a specified associated phase loses ROW. The associated phase must be a fixed phase.

The normal use for this type of phase is an indicative green arrow as illustrated with Phase C in Figure 21.2 & Figure 21.3.

3.11 EARLY TERMINATION OF PHASES

Once a phase has gained ROW in a stage it cannot normally be terminated before the end of the stage.

If early termination of a phase is required, usually for a pedestrian phase, it is achieved by using two consecutive stages. The phase that is to terminate early is allocated to the first stage while the other phases that are to stay at ROW are allocated to both stages.

The normal method of operation is for a demand to be inserted for the second stage when the first stage becomes active. A stage change will then occur following the expiry of the minimum green of the early terminating phase.

The controller is programmed so that the stage change occurs without an interstage to give the appearance of one stage instead of two.

Variations of this method of control may also be achieved.

4. DEMANDS AND EXTENSIONS

4.1 GENERAL DESCRIPTION

Demands may be inserted for phases or stages, but extensions may only be inserted for phases. Demands will only be acted upon when the relevant phase or stage is not active, whereas extensions will only be acted upon when the relevant phase is active.

4.2 TYPES OF DEMANDS

4.2.1 Latched

The demand remains active until the phase or stage is served.

All priority demands are latched irrespective of the current mode. In order to provide an unlatched facility special conditioning is required (see Section 9.4 for reference).

4.2.2 Unlatched

The demand is cleared if the demand condition ceases before the phase or stage is served.

Any maximum green timers started by an unlatched demand will be reset if all of the opposing demands are cleared.

4.3 ORIGINS OF DEMANDS AND EXTENSIONS

4.3.1 On-Street Detection Equipment

This refers to the approach detectors at the intersection. Figure 21.7 illustrates the requirements of the detectors for the inter-section in section 21.

4.3.2 Pedestrian Push-Buttons

These insert latched demands and also illuminate the WAIT indicators of their respective pedestrian phases.

If it is required, it is possible to illuminate the WAIT indicator without inserting a demand or conversely insert a demand without illuminating the WAIT indicator.

In the example in Figure 21.7 push-buttons 1 & 2 are required to demand pedestrian Phase G.

4.3.3 Revertive Demands

When a vehicle actuated phase terminates with an extension active, a revertive latched demand is inserted for the phase to prevent any vehicles being trapped between the detectors and stop line without a demand for the phase.

If required, the revertive demand may be inserted for an alternative phase rather than for the terminated phase.

In the example in Figure 21.5, the green arrow Phase C inserts a revertive demand for its associated Phase B, and dummy Phase H for Phase F.

4.3.4 UTC Demand Bits

These provide simulated on-street demands and/or extensions from the UTC computer. In the case of pedestrian demands, the WAIT indicator will be illuminated on receipt of the demand unless specifically requested otherwise.

4.3.5 Conditions Occurring

Demands and/or extensions may be required to be inserted when certain conditions occur rather than the operation of detectors. For example, a stage becoming active inserts a demand for a following stage.

4.3.6 Repeat Pulses

When controllers are linked, demands and/or extensions may be required to be inserted when certain conditions occur in the first controller and the pulses are repeated to the second controller. (See section 13.2).

4.3.7 SDE/SA

This facility provides extra extensions to phases for high speed vehicles, see section 6.

4.3.8 Handset

Demands and extensions for phases may be inserted via the handset using the IOP command.

Type in IOP 0 enter. Then pressing keys 0-7 will insert demands/extensions on port 0, all the time the key is pressed. The ‘+’ and ‘-’ keys may be used to quickly move up and down to other ports.

Alternatively, fixed demands and extensions for phases may be inserted and removed via the handset using the PHD and the PHE commands.

4.4 OPERATION DURING CERTAIN MODES

4.4.1 Manual, Fixed Time and Start Up Mode

During Manual and Fixed Time Mode demands and extensions are disregarded. This does not apply when Fixed Time to Current Maxes is the operative mode, see section 9.11.2.

However, demands are inserted for all non-running real phases when these modes terminate. Pedestrian phase WAIT indicators will be illuminated while a demand is present.

4.4.2 UTC

For UTC it is possible to configure the following:

1. Which phases and/or stages have latched or unlatched demands inserted when a certain UTC demand bit is applied.

2. Which phases are extended by which UTC demand bits.

3. Demand dependent force bits and for each force bit which demands are to be considered.

4.4.3 Mode

Extensions are disregarded during CLF mode. However, it is possible to configure demand dependant moves to stages during CLF. This is achieved by selecting the group influence as a demand dependant move to a stage and specifying the stage.

Two alternative movements can also be specified by selecting the ‘Add demand dependant move’ group influence.

4.4.4 Disabling Modes

There is a table in the specification sheets for disabling modes on a per stream basis. If this is filled in, the modes specified will be deleted permanently as it will be configured into the controller. However, if modes are to be disabled under certain conditions, the same parameters are available to special conditioning and thus special conditioning may be used to delete modes.

5. CALL/CANCEL

5.1 GENERAL

There are up to 8 call/cancel units (0 to 7) available which may be used for turning movements or in conjunction with queue loops or switched facilities.

The input to a unit must remain active for the call period before the output goes active, and inactive for the cancel period before the output returns to the inactive condition.

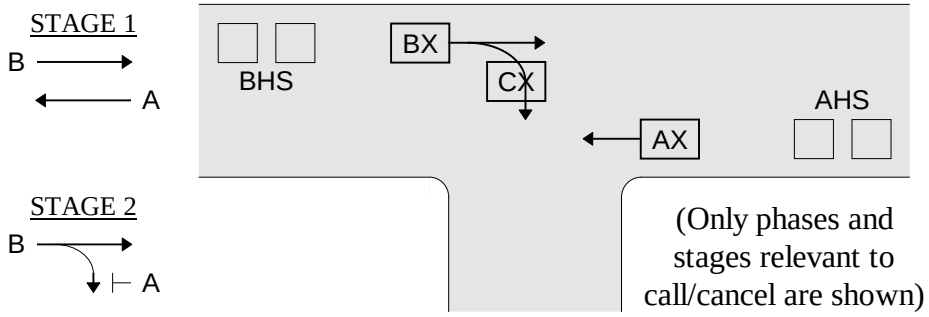
If the call/cancel unit is used for a turning movement, then the output would be configured to insert an unlatched demand for the appropriate phase to allow for it to be cancelled.

The call and cancel delay times that are programmed may be changed via the handset using the DCL and DCN commands.

The timing range of both the call and cancel period is 0 to 255 seconds in 1 second steps.

In the example in Figure 21.7, detector loop C1 must be occupied for 3 seconds for the demand for Phase C to be inserted and unoccupied for 3 seconds for the demand to be cancelled.

5.2 CALL/CANCEL - METHODS OF USE



In this situation the controller can be configured to operate in various ways as shown, where

AX - always calls and extends phase A.
BX - 1) extend stage 1 only, or
2) extend stage 1 until call for stage 2 then extend stage 2, or
3) extend stage 1 and stage 2
CX - a call/cancel that demands and extends stage 2

Note:- A demand for stage 2 may or may not be dependant on a side road demand. If it is not, then a backwards move from stage 2 to 1 via all red must be allowed.

For details on the high-speed detectors AHS and BHS, see section 6.11.

6. HIGH SPEED VEHICLE DETECTION

To provide this facility, an SDE/SA processor PCB and soundmark interface socket must be added to the controller. This fits in the PCB module beside the Main Processor Board. Unused input lines on the SDE/SA PCB may be used as general inputs.

On roads where high speed vehicles are required to be detected to ensure safe passage through an intersection, one of two methods may be used:

- SDE, double or triple, where a fixed extension is generated.
- SA, where a fixed extension is generated after a variable delay dependent on the vehicle speed.

6.1 SPEED DISCRIMINATION EQUIPMENT (SDE)

Each traffic lane is provided with either one or two speed measurement points, assessors, situated further from the stop line than the normal detectors, to implement either double or triple SDE. An assessor consists of two loops (A and B) with a 12ft leading-edge to leading-edge spacing. The loop-loop traversal time gives a measure of the vehicle speed. A vehicle travelling over an assessor above a preset threshold generates a preset extension for the approach phase green, to retain ROW until the vehicle reaches the normal point of detection.

See Figure 6.1(a) and (b) for a sketch of the layout.

6.1.1 Double SDE

This facility is used at intersections where vehicle approach speeds in excess of 35mph (56Km/hr) and less than 45mph (72Km/hr) are normally anticipated. Alternative speeds may be configured if required.

The standard assessment speed is 30mph (48Km/hr) and the distance of the assessor is 79 metres from the stop line. A fixed extension period normally of 3.0 seconds is provided for each vehicle exceeding the threshold velocity. Alternative extension periods may be configured if required.

6.1.2 Triple SDE

This facility is used where vehicle approach speeds in excess of 45mph (72Km/hr) and less than 65mph (105Km/hr) are normally anticipated. Alternative speeds may be configured if required.

Two assessors are used, an outer and an inner. The outer is situated 159 metres from the stop line and the inner 91 metres. The outer assessor has a threshold velocity of 45mph (72Km/hr) and the inner 35mph (56Km/hr). A fixed extension period normally of 3.5 seconds is provided by each assessor for vehicles exceeding the threshold velocity. Alternative extension periods may be configured if required.

6.1.3 SDE Extension Inhibit

An SDE extension may be suppressed, but not the associated extra clearance, by using a Special Conditioning mask. This would be used in an early cut-off situation where the overlapped phase would not be required to be extended by its SDE loops during the turning movement. In the example shown in section 21, Phase B SDE extensions would be inhibited during Stage 2.

6.2 SPEED ASSESSMENT (SA)

Each traffic lane is provided with an assessor situated 151 metres from the stop line. A vehicle crossing the assessor at a speed above 28mph (45Km/hr) generates a fixed extension of 5.0 seconds after a delay period which is dependent on the vehicle speed. The faster the vehicle speed the less the delay period is. Above 62mph (100Km/hr) the delay period is zero.

See Figure 6.1(c) for a sketch of the layout.

The formula for calculating the delay period is:

$$\text{Delay} = \frac{(140)}{(V)} - 5 \text{ seconds}$$

where V is the measured vehicle speed in metres per second. For example, the delay at 30 mph is 5.5 seconds and the delay at 45 mph is 2 seconds. During the delay period, a normal gap change can occur.

6.3 ASSESSORS AVAILABLE

There are up to 16 assessors (0 to 15) available for use on SDE or SA.

6.4 EXTRA CLEARANCE PERIODS

Each phase which is equipped with SDE or SA can be allocated an extra clearance period to extend the subsequent intergreen. The extra clearance period for each phase will be introduced if any of the following conditions occur:

(a) An SDE or SA extension is active for the phase during its amber leaving state.

(b) Any speed measurement detector does not detect a vehicle during the associated phase green period.

(c) Optionally any extension (speed extension, green extension or Priority extension) is active for the phase when it changes from green to amber leaving.

The condition in (c) is normally disabled for individual phases at the time of configuration. Speed extensions will still request extra clearance because of the operation of condition (a).

An extra clearance period will be given under any mode of control, i.e. manual, VA, fixed time, CLF, UTC, vehicle priority or hurry call. Its effect is to increase all the inter-green timings for the phase which is being given the extra clearance, and also to increase the phase change delay times for gaining phases.

This latter increase is computed as the largest of the extra clearance times currently applied for that stage to stage move.

Phase change delay times for individual gaining phases may be configured so that they are not increased when a specific phase is requesting an extra intergreen due to SDE/SA.

NOTE: If the inter-green is not dependent on the SDE/SA phase inter-green time (because another losing phase has a longer inter-green time) then the extra clearance period may not actually delay the appearance of the gaining phase.

The range of the timing period for the extra-clearance is 0 to 50 seconds in 1 second steps for each SDE/SA phase.

The programmed value may be changed via the handset using the SCT command.

6.5 SDE/SA PARALLEL STAGE STREAMING FACILITIES

If a phase with SDE/SA is requesting extra clearance and so increasing the time in its associated intergreen timer, it is possible to specify at configuration which delay timers (for phases gaining ROW) are to also be increased. In this way, it is possible to specify delay timers just for the phases appearing in a particular stream, whilst not increasing those in other streams.

6.6 SDE/SA ON GREEN ARROWS

Where these are single aspect, the red and amber drives of the Phase Switch PCB are not available to drive other green arrows, as they must be programmed as 3-aspect to get the amber signal to meet the requirement of 6.4, even though only the green arrow is connected. (See section 18).

6.7 COMMON APPROACH LANES

Where an assessor is associated with a number of phases, then all the phases that require speed extensions and extra clearance periods can be driven from that assessor. If this is required then the phase termination's should not be staggered.

6.8 OTHER LOOP SPACINGS

The SDE/SA facility can be configured to operate with 10 ft. loop spacing. Note that all SDE/SA loops on the site must be 10ft. loop spacing. However, it is recommended that all the loops are re-cut for 12ft loop spacing and the Controller configured for 12ft. operation.

6.9 EQUIPMENT

The SDE/SA facility is provided on a separate PCB which fits into the PCB Module beside the Main Processor Board. It contains enough inputs for up to 16 assessors (i.e. 32 inputs). Any inputs not required may be used for other input facilities, i.e. detectors or push-button.

A jack socket is provided for interface to a Soundmark or equivalent test set.

An additional detector power supply may be required. See the Detector Power Supply Section for the supply requirements of externally mounted vehicle detection equipment.

6.10 EXAMPLE

Figure 21.18 shows an example of requirement of Double SDE on Phases A, B and C tying in with the intersection in section 21. Phase A is one approach and Phase B and C are another approach with Phase C being a right turn indicative green arrow. Phases A and B have been requested not to have extra clearance if a non high speed extension is active at phase termination.

6.11 HIGH SPEED DETECTORS WITH CALL CANCEL

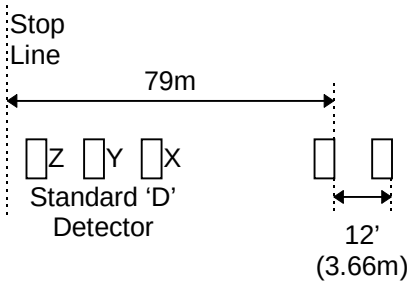
In the diagram in section 5, the AHS and BHS were high-speed detectors:-

Detector AHS - Extends phase A and extend the intergreen following phase A if any high speed vehicle is detected.

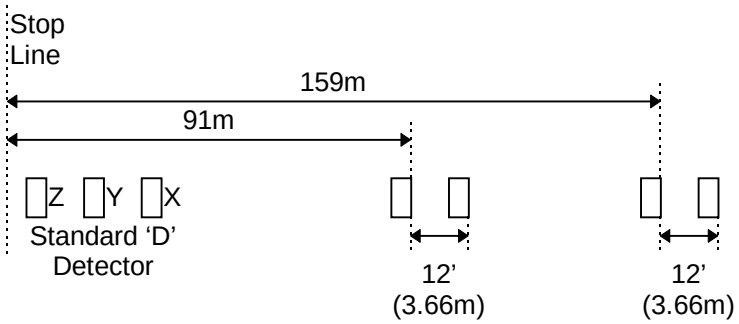
Detector BHS - 1) In case 1 above extends stage 1 only
2) In case 2 above extends stage 1 until a call for stage 2 and then will extend stage 2
3) In case 3 above extends stage 1 and 2.

AHS must extend the I/G green following termination of phase A if a high speed vehicle is detected. In all 3 cases detector BHS should extend the intergreen following termination of phase B if a high speed vehicle is detected, i.e. leaving stage 1 or 2.

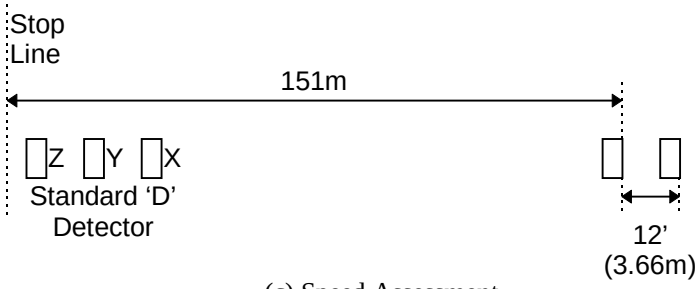
Figure 6.1 - SDE/SA LAYOUTS



(a) Double SDE



(b) Triple SDE



(c) Speed Assessment

7. ALL-RED DISPLAYS

There are two methods of achieving an all-red display:

- All-red stage
- Red extension during intergreen.

An All-Red Stage is a stage during which all signal phases display their red signal aspects.

The red condition between conflicting phases in certain stage to stage transitions can be extended up to a pre-determined maximum. One red extension value and one maximum red value is provided for all stage to stage transitions.

The programmed value may be changed via the handset using the commands in brackets.

The range of timings are:

Red extension (REX) - 0 to 31.8 seconds in 0.2 second steps
Maximum red (RMX) - 0 to 255 seconds in 1 second steps

(See also section 2.6.6).

If alternative extension or maximum red periods are required for different red periods this can be achieved by the use of separate All-Red stages. Care should be taken to ensure that any all-red extensions in this case operate as required during different modes.

7.1 ALL-RED STAGE

The All-Red Stage can be called automatically and used to provide a ‘buffer stage’ between conflicting phases, e.g. as shuttle working on bridges or on moves from an indicative green arrow turning movement back to the main movement. In the intersection in section 21 the move 2-1 goes via stage 0.

Note: if Stage 0 is used for changes to stages other than Stage 1, problems can arise as the controller will decide on stage changes cyclically.

The All-Red Stage can have a minimum period which can be extended by the relevant detectors up to a maximum period. This is achieved by allocating a dummy phase to the stage to provide a minimum green, green extension and maximum green. In the intersection in section 21 phase J is in Stage 0.

Any of the stages available, including Stage 0 can be considered as an All-Red Stage.

During manual operation, All-Red Stages cannot be extended by All-Red detectors, they will just be displayed for the minimum period.

7.2 RED EXTENSION DURING INTERGREEN

The occupation of an All Red detector loop during its specified stage to stage movement will generate an All Red extension.

When using priority mode to provide priority facilities for Light Rail Transit schemes, the priority demands (LRV requests) can be used to extend the all Red period. The all red extensions called by LRV requests can be configured to be different depending upon the stage being left (flexible all red).

(N.B. As the extend all red signals are available in special conditioning, the extend all red period may be introduced due to special conditions when required.)

The extension will continue all the while the loop is occupied. When the loop is cleared the extension will continue for a fixed period - the All Red Extension period.

When the first phase in the stage that is about to go to green reaches the start of its red-green transition period, all intergreen and delay times concerned with the intergreen will be held until either the All Red Extension period or the All Red Maximum period terminates. (See also section 8.2).

During the red extension period, any phase change delay timing is suspended (i.e. any further delays given to phases gaining ROW after the extended red condition will occur unchanged).

During all modes, except Fixed Time Mode, the red extension and maximum red period can operate as normal or, if required, the extended red period can be automatically extended up to the maximum red value. (See Figure 21.9).

During Fixed Time Mode, the controller automatically extends the red period up to the maximum red value for safety reasons.

There are 7 facilities (units 1 to 7) available for different sets of all-red detectors. If one set is to be used for several stage to stage transitions, then this would only require one facility.

Care must be taken to ensure that no stage to stage movement is repeated on different facilities (units). In the example in Figure 21.9, it would not be possible to satisfy a requirement to extend the all red on the stage movement 1 to 3 using facility unit 3, as this movement has already been specified against facility unit 1.

This restriction is due to the fact that the stage to stage movements for the 7 units mentioned are specified in a binary fashion in three tables, see the example overleaf:

Stage movements for all red units are specified as follows:

Unit 7	1 - 2
Unit 6	1 - 3
Unit 5	2 - 3
Unit 4	4 - 5
Unit 3	4 - 6
Unit 2	5 - 8
Unit 1	8 - 1

TABLES

Units	3 Binary Value 4	2 Binary Value 2	1 Binary Value 1
7	1 - 2	1 - 2	1 - 2
6	1 - 3	1 - 3	
5	2 - 3		2 - 3
4	4 - 5		
3		4 - 6	4 - 6
2		5 - 8	
1			8 - 1

As can be seen from above, the stage moves are entered in the appropriate tables to equate to the required unit. Thus a movement cannot be specified for two units.

In the example in Figure 21.9, all-red detectors AR1 & AR2 are required to extend stage transitions 1-2, 1-3 and 1-4, while AR3 & AR4 are required on 3-1 & 3-4. An extension time of 2.0 seconds and a maximum time of 12 seconds are required.

7.2.1 Independent Intergreens

In some circumstances, when a normal Extend All Red (Hold Intergreen) is applied to an intersection, there are some phases to which the Intergreen Extension applies, which are not involved in the conflict, and so whose appearance does not need to be delayed. In order to cater for this requirement, the Independant Intergreen Facility has been incorporated within the software. It is possible to specify at configuration, for each terminating phase, the intergreens to the gaining phases which will not be held by the Extend All Red facility.

7.2.2 Extend All Red (Hold I/G) Parallel Stage Streaming Facilities

There is an extend all red Facility available on each stream. There is a separate All Red Extension time and All Red Maximum time for each stream. If the extend all red input is active on the specified stage to stage movement, then when the first phase in the stream that is about to go to green reaches the start of its red-green transition period, the intergreen and delay times concerned with the intergreen are held until the All Red extension period terminates or the All Red Maximum time is reached. (See also section 19.2.)

NB Care must be taken when using/testing independent intergreens. The Extend All Red ceases when the gaining stage comes to fruition (i.e. when all fixed phases are at right of way). Therefore the following situation is possible; if the intergreens to all fixed phases are independent and it is the intergreen to a non-fixed phase to which the intergreen extensions apply, **then** as the intergreens to all the fixed phases are not held by the extensions, they will gain right of way after their normal intergreens and the gaining stage will come to fruition, which will then terminate the intergreen extension for the non fixed phase. This may mean that the intergreen extension for the non-fixed phase is terminated prematurely, i.e. before the Max All Red timer or the loss of the extension input would have terminated it.

Each stream's all red extension time may be accessed using the handset command: REX followed by the stream number (e.g. REX1).

Each stream's all red maximum time may be accessed using the handset command: RMX followed by the stream number (e.g. RMX2).

8. PHASE DELAYS

8.1 GENERAL DESCRIPTION

In order to gain more efficient use of phases during stage to stage transitions, it may be required to delay specific phases from losing or gaining ROW.

There are up to 60 phase delay times (0 to 59) available for different phases on different stage to stage transitions.

The timing range is 0 to 255 seconds in 1 second steps.

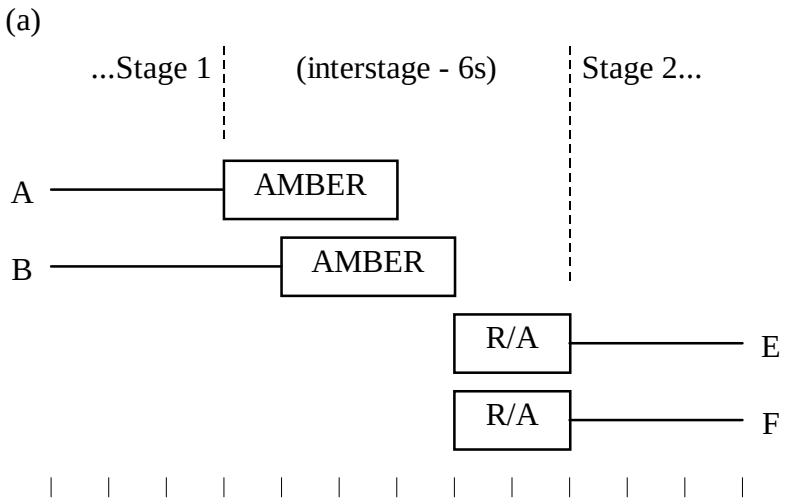
The programmed value may be changed via the handset using the DPG command.

8.2 PHASES LOSING RIGHT-OF-WAY

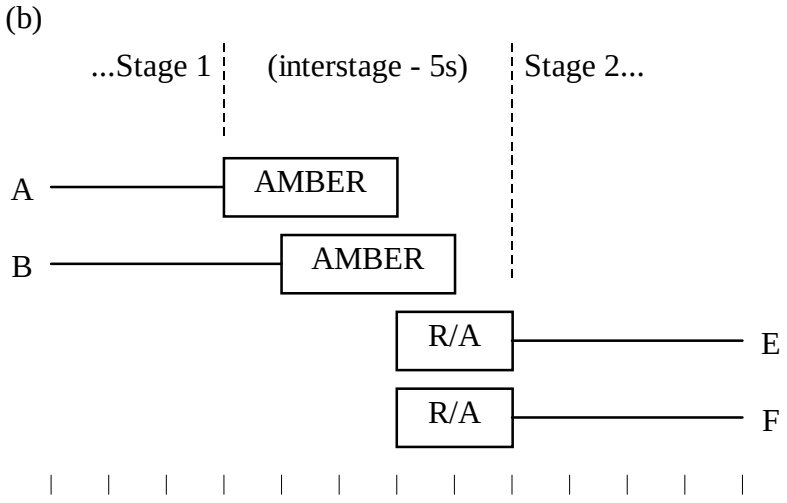
A phase may be delayed from losing ROW on a specific stage to stage transition to obtain a clearance period. The delayed phase is held at green during the interstage for the period of the delay time, while non-delayed phases that do not appear in the next stage terminate. Any intergreen periods from the delayed phase to conflicting phases will not commence to time until the phase delay period has expired, even though other intergreen timers from phases already terminated will have started and possibly terminated. Therefore any phases gaining right of way may have their appearance delayed as a result of the difference in intergreen times, unless the intergreen times allow for the phase delay time.

For example, in Figure 8.1 (referring to the intersection in section 21), Phase B is to be delayed by 1 second on a move from Stage 1 to 3, to give a short clearance period. Figure 8.1(a) illustrates that if the intergreen (I/G) B-E/F was 5 seconds, the same as I/G A-E/F then Phases E and F would appear 1 second late giving an effective I/G A-E/F of 6 seconds. To overcome this, in Figure 8.1(b) I/G B-E/F has been reduced to 4 seconds to allow for the 1 second delay on Phase B and the I/G A-E/F remains at 5 seconds.

Figure 8.1 - DELAY PHASE LOSING RIGHT-OF-WAY

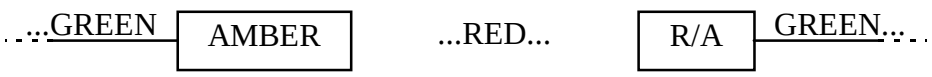


Phase B is delayed by 1 second.
Intergreen from Phase A to Phases E and F is 5 seconds.
Intergreen from Phase B to Phases E and F is 5 seconds.



Phase B is delayed by 1 second.
Intergreen from Phase A to Phases E and F is 5 seconds.
Intergreen from Phase B to Phases E and F is 4 seconds.

Key:-



8.3 PHASES GAINING RIGHT-OF-WAY

The intergreen times from a conflicting phase determines at which point a phase gains ROW. If phases gaining ROW have different intergreen times from a conflicting phase then they will gain ROW at different points. The time differences will be the same every time the phase to phase transition occurs regardless of the stage to stage transition. For example, in Figure 8.2(a) (referring to the intersection in section 21) if the I/G E-A/G is 5 seconds and the I/G E-B is 6 seconds then, whether on a move 3-1 or 5-1, Phase B will gain ROW 1 second after Phases A and G. If it is required to have an I/G E-B of 6 seconds on a move 5-1 then this would be achieved by having an I/G E-B of 5 seconds and delay Phase B by 1 second on a move 5-1. Figure 8.2(b) illustrates the move 3-1 and Figure 8.2(c) the move 5-1.

Figure 21.4 indicates where to request the phase delay facilities.

8.4 DELAY TIMER

Whether a phase is losing or gaining ROW, the delay timer starts when the leaving stage terminates.

If a phase losing ROW is delayed, it will be prevented from terminating (i.e. held at green) for the delay period.

If a phase gaining ROW is delayed, it will be prevented from gaining ROW (i.e. held at red for traffic and pedestrian phases and blackout for green arrow phases). In this case the delay time must include the longest intergreen time to the phase on this transition plus the actual delay required. In the case of a traffic phase the red/amber time (i.e. 2 seconds) is not included in the total sum.

In the example in Figure 8.2(c) to delay traffic Phase B from gaining ROW by 1 second the delay timer time will be:

	5	(I/G E-B)
+	1	(delay required)
-	2	(red/amber)
=	4	(total delay timer time)

Note: If phase B had been a Green Arrow or Pedestrian phase it would be:

	5	(I/G E-B)
+	1	(delay required)
-	0	(no RED/AMBER)
=	6	(total delay timer time)

8.5 PHASE DELAY HANDSET COMMANDS

There are three handset commands which can be used to specify phase delays or modify information previously entered in the configuration prom. Up to 60 entries can be made to specify the phase to be delayed, how many seconds it is delayed by, and on which stage to stage movement the phase is to be delayed.

`DPG` - The Phase Delay time in seconds.
`DMV` - Updates Delayed phase Movement Table.
`DFZ` - Updates Phase to be delayed Table.

`DMV x=y` - x is in range [0 - (No. of phase delays configured - 1)] and is a decimal number.
- y is a hex no. where the left hand digit of y indicates the 'from' stage and right hand digit of y indicates the 'to' stage.
- e.g. y = 35H indicates a phase is delayed when going from stage 3 to stage 5 (the phase to be delayed will be specified in the appropriate position in the phase to be delayed table).

`DFZ x=y` - x is in range [0 - (No. of phase delays configured - 1)] and is a decimal value.
- y is a letter indicating the phase to be delayed.
- If the 10th phase delay was to delay Phase F then entry is DFZ 9=F.

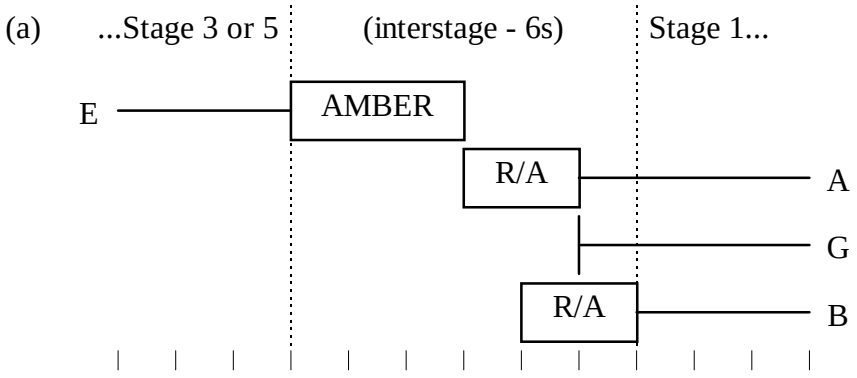
Thus, if we wanted to introduce a new phase delay to the existing 10 phase delays in a given configuration we could do it via the handset. For example delay phase E for 12 seconds in going from stage 2 to stage 1:

```
DMV 10=21
DFZ 10=E
DPG 10=12
```

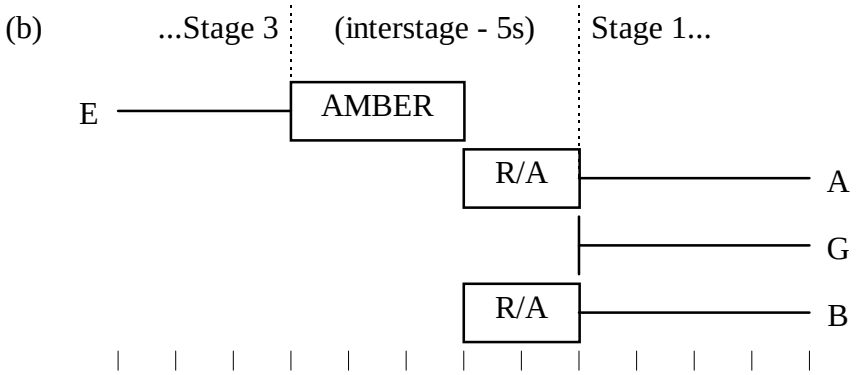
8.6 EFFECT OF RED EXTENSIONS AND SDE/SA

During the red extension period or SDE/SA extra clearance period (see sections 7.2 and 6.4), delay timings for phases gaining ROW are suspended and the delays will occur unchanged at the end of the period. However, it is possible to configure delay times for individual gaining phases such that they will not be suspended during an extra clearance requested by SDE/SA (see section 6.4).

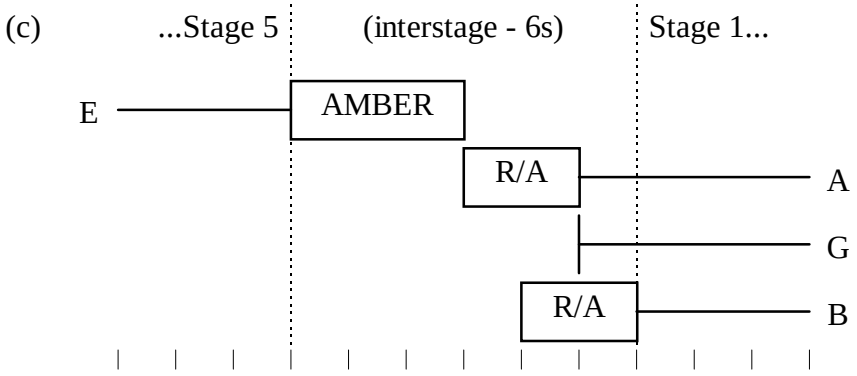
Figure 8.2 - DELAY PHASE GAINING RIGHT-OF-WAY



Intergreen from Phase E to Phases A and G is 5 seconds.
Intergreen from Phase E to Phase B is 6 seconds.

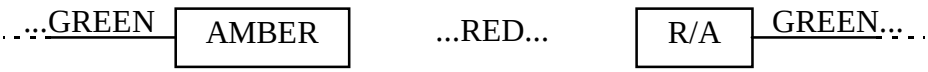


Intergreen from Phase E to Phase B is 5 seconds.



Intergreen from Phase E to Phase B is still 5 seconds, but
Phase B is delayed by 1 second more than the intergreen.
(4 second phase delay plus 2 second red/amber = 6 seconds)

Key:-



9. MODES

The following modes are available:

(a) Fixed Time (FT)
(b) Vehicle Actuated (VA)
(c) Cableless Linking
(d) Manual Operation
(e) Hurry Call
(f) Urban Traffic Control.
(g) Part Time (Off period)
(h) Start Up
(i) Manual Operation (Selected via mode switch)
(j) VA, CLF or FT Operation (selected via mode switch)
(k) Emergency Vehicle
(l) Priority (Non-emergency vehicle)
(m) Manual Step-On, if fitted.
(n) Pelican FVP mode
(o) Pelican VA mode

Selection of the modes is influenced by the following:

- Status of the incoming hurry call signals.
- Status of the UTC force and demand signals.
- Status of the Priority Inputs.
- Status of the manual select buttons
- Status of Part time requests.
- Timeswitch/CLF signals.
- Conditioning signals.
- Integrity of the hardware/software.

The mode priorities are defined during controller configuration with the following restrictions, assuming all stipulated modes are utilised:

- Signals off periods during the part time cycle have highest priority.
- Hurry call modes 0 and 1 are in descending order but not necessarily consecutive priority. Both hurry call modes must be higher priority than the VA mode.
- Cableless linking mode must be higher priority than VA mode.
- Fixed time mode is always the lowest priority.

With the mode priorities defined, the controller adopts the highest priority mode for which the following conditions of entry apply:

- Part time off (or flashing) period: Part time off selected by master time clock.
- Hurry call mode: Hurry call applied and any call delay expired.
- UTC mode: When the UTC mode code has been received by the controller.
- Manual Control selection: MANUAL selected on the manual panel.
- Cableless linking mode: A valid cableless linking plan is selected by the master time clock.
- Bus/LRT/Emergency Vehicle mode: Entered if a request exists for priority from a special vehicle detector, (e.g. LRT request).
- Vehicle actuated mode: Entered if a request does not exist for a higher priority mode.
- Fixed Time mode: If no other mode is available this mode is run.

9.1 START UP MODE

The start up mode is entered to produce a safe signals on sequence when any of the following conditions occur:

- The a.c. supplies to the controller are switched on or restored following a failure, provided part time off is not selected.
- The signals are switched on by means of the SIGNALS ON/OFF switch or the signals isolating switch (if fitted), provided part time off is not selected. This facility is optional. The alternative option is that the signals turn on immediately at whatever point in the cycle the controller has reached when the SIGNALS ON/OFF switch is switched on.
- The signals are switched on by the master time clock at the end of a part time off period.

9.1.1 Normal Start-up Sequence

The standard start-up sequence consists of three periods:

(a) Start-up Period

The start-up time is a period of 7 seconds which commences at the start of the ‘signals on’ command. During this period all signals for all phases are off.

(b) Amber Leaving/Red Display.

Following the blackout an amber leaving signal is shown to all traffic phases not in Stage 1, continue signals off to all traffic phases in Stage 1 and a red signal to all pedestrian phases.

(c) Starting Intergreen

At the end of 3 seconds amber leaving, the traffic phases not in Stage 1 change to red, the traffic phases in Stage 1 continue at signals off and all pedestrian phases continue at red. This state continues until the end of the starting intergreen time (as specified in Figure 21.4), when the traffic phases in Stage 1 change straight from signals off to green and any pedestrian phase in Stage 1 change from red to green as normal. Any green arrow phases in Stage 1 will illuminate as normal.

The start-up mode is now finished and the controller will assume the highest priority mode. During the start-up sequence demands are inserted for all phases to prevent any vehicles being trapped against a red signal.

9.1.2 Optional Start-Up Sequence

The start up sequence is as follows:

0 seconds	All signals off.
7 - 10 seconds later	All 3 aspect vehicle phases and pedestrian phases show the red condition and the starting intergreen period starts. The Phase will remain at Red for the duration of this period which consists of the Starting Intergreen time plus an additional time equal to the amber leaving time (3 sec).

Following the red period above, phases in the startup stage are set to green. (Start up stage is the one selected to be the first stage to become active after start-up.)

The start-up mode is now finished and the controller will assume the highest priority mode.

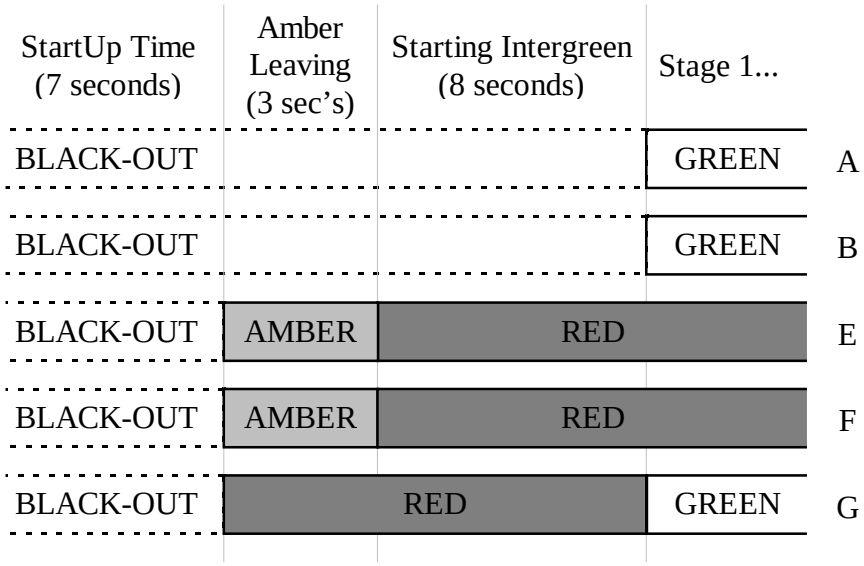
Also during the start up mode, demands will be inserted for all configured real phases (not dummy phases), to ensure that no vehicles are trapped against a red signal.

Note the start up stage should not be deleted. (As controller will fail to start up if start up stage is deleted.)

9.1.3 Start Up Parallel Stage Streaming Facilities

The start-up stage for each stream is configurable. This determines the stages that the controller starts up in when powering up, when coming out of Part Time, or after the signals have been switched off from Special Conditioning (using the method that implements start-up). Figure 9.1 illustrates the start-up sequence for the intersection in section 21.

Figure 9.1 - START-UP SEQUENCE



9.2 PART TIME MODE

During part-time mode, normal traffic control operations are suspended and signals blackout is selected. In order to achieve this, Part-time mode must always be programmed as the highest priority mode.

On the change from normal to off, ROW moves immediately to Stage 1, subject to any delays caused by minimum greens or intergreens timing off and also subject to any stage movement restrictions. Following the expiry of all minimum greens in Stage 1, the signals are extinguished.

On the change from off to normal, the Start-up mode is entered to ensure normal operations resume in a safe manner.

The normal method of switching from Part-time mode to normal traffic operations is by means of the master time clock at specified times of the day.

An alternative method is by means of queue detectors. If a queue of traffic is detected then Part-time mode is deleted and normal traffic operations are introduced for a certain period e.g. 20 minutes. At the end of this period, Part-time mode is re-introduced unless a queue is still being detected, in which case the normal traffic operations will continue until the queue is not detected for a certain length of time.

Alternative signal sequences, e.g. flashing amber for traffic phases during night-time may be obtained if required (for Export Controllers ONLY).

For alternative signal sequences, see section 14.

Part-time mode may be used to introduce flashing amber by the following methods.

a) Handset

b) Manual Panel switch (SW1, 2 or 3 as configured.)

c) Time switch event

See the special conditioning section 20.3 for an example.

Note: it is a requirement of the Department of Transport that Part-time mode may only be used if accompanied by a Red Lamp Monitoring facility, see Section 19.2.

9.3 URBAN TRAFFIC CONTROL (UTC) MODE

(Normally an O.T.U. is required for this facility.)

In UTC mode, operations are controlled and monitored by the central computer of an Urban Traffic Control system.

Stage changes are effected by the application of forces and demands. The demands may either be local or simulated by the computer. During UTC mode maximum green timers normally have no effect and are held in a RESET state.

Instation equipment at the central computer office communicates via telephone lines to an outstation transmission unit (OTU) housed within the controller. This method conforms to Department of Transport Specification MCE 0312.

Control signals are transmitted as two 8-bit control words and monitoring signals are returned as two 8-bit reply words. Figure 21.14 illustrates a bit format for the intersection in section 21.

Interfacing of the control and reply signals between the OTU and the controller is via reed relay buffers (see section 15).

The logic states of the control and reply bits at the controller are as follows:

	ACTIVE	INACTIVE
CONTROL:	'CLOSED (1)'	'OPEN (0)'
REPLY:	'OPEN (0)'	'CLOSED (1)'

Any unused reply bits are usually set to the inactive state.

9.3.1 Method of Plan Introduction

Certain contracts require that the controller must synchronise with the Plan quickly.

To achieve this, the following constraints are placed on the UTC facility:

The Stage movement restraints table used by UTC should not have purely prohibited moves or Ignore moves configured. They should either be allowed moves or if this is not acceptable for safety reasons, then alternative moves should be specified. If alternatives are specified, it is preferable for the alternative stage to be one or two stages ahead in cyclic order of the original target stage, for example:

if the move 1-2 is not to be allowed,
the alternative could be 1-3 or 1-4.

9.3.2 Summary of Control and Reply Bits

Control Bits

Section	Bit designation	Title
(a)	DX	Demands - Common
	D1, D2 etc.	Demands - Stage
(b)	F1, F2 etc.	Forces
(c)	SF1 and SF2	Switch Facility
(d)	SO	Solar Override
(e)	SG	CLF Group Synchronisation
(f)	LO	Lamps On / Off
(g)	LL	Local Link Inhibit
(h)	FM	Fall Back Mode
(i)	TO	Take Over
(j)	TS	RTC Set to stored value
(k)	TS1	RTC Synchronisation
(l)	TC	Transmission Confirm

Reply Bits

Section	Bit designation	Title
(a)	G1, G2 etc.	Stage Confirm
(b)	DF	Detector Fault
(c)	SC1 and SC2	Switch Facility Confirm
(d)	GR1	First Group Confirm
(e)	CS	CLF Group Sync. confirm
(f)	SD1, SD2 etc.	Stage demand confirm
(g)	FC	Fall Back Confirm
(h)	HC	Hurry Call Confirm
(i)	MC	Manual Control Mode
	RR	Remote Reconnect
(j)	CF	Controller Fault
(k)	LE	Lamps Off
(l)	CC	RTC Sync. Confirm to Stored Value
(m)	CC1	RTC Sync. Confirm
(n)	TOR	Take Over Confirm
(o)	SC	Solar Override Confirm
(p)	TF	Test Facility
(q)	FR	Signals Flashing
(r)	LC	Local Link Inhibited

9.3.3 Control Bits

See Figure 21.14

9.3.3(a) Demands - Common (DX) and Stage (D1,D2 etc.)

A ‘D’ bit simulates local demands, i.e. detectors or pedestrian push-buttons.

‘DX’ bit normally demands all phases and extends all extendible phases.

‘D’ bits normally demand and extend (where required) the phases within the specified demand dependent stage.

The demands may be latched or unlatched as required, although normally they are latched.

Demands for pedestrian phases do not normally illuminate the WAIT indicators, although they may be programmed to if required.

Timing delays associated with call/cancel facilities are not applicable, although demands may still be unlatched.

Any demands dependent on other demands may still be effective.

The demands may be programmed so that they are only effective if the appropriate ‘F’ bit is present with the ‘D’ or ‘DX’ bit.

If required it is possible to program the controller so that demands for phases may be ignored for certain stages.

‘D’ bits may be used during CLF, VA, Bus Priority or Emergency Vehicle modes as well as UTC mode.

In the example in Figure 21.14, ‘DX’ demands all phases and extends all extendible phases. ‘D2’ demands and extends phase C and ‘D4’ demands phase H.

See also 9.3.4(9.3.4(f)).

9.3.3(b) Forces (F1,F2 etc.)

An ‘F’ bit forces the controller to make an immediate move to the specified stage, subject to any minimum green or intergreen periods timing off and any stage movement restrictions.

An ‘F’ bit may be demand dependent if required. If it is, the move will only occur if there is a demand for a phase within the specified stage.

In the example in Figure 21.14, ‘F2’ and ‘F4’ are demand dependent forces.

See also 9.3.4(9.3.4(a)).

9.3.3(c) Switch Facility (SF1 and SF2)

An 'SF' bit may be programmed to simulate any one of the facilities provided by the Event Timetable.

See also 9.3.4(9.3.4(c)).

9.3.3(d) Solar Switch Override (SO)

An 'SO' bit may be programmed to override the Signal Dimming facility and switch the signals to the BRIGHT condition.

See also 9.3.4(9.3.4(o)).

9.3.3(e) CLF Group Synchronisation (SG)

An 'SG' bit may be programmed to reset the current CLF plan and cycle time to the start of the first group, i.e. Group O.

The synchronisation code is transmitted four times at 0101 levels, each level of 1 second duration.

The reset is actioned within 300 ms of the leading edge of the second '1' bit.

See also 9.3.4(9.3.4(e)).

9.3.3(f) Lamps On/Off (LO)

If part-time mode is configured it may be programmed to be introduced by the presence of an 'LO' bit. The 'LO' bit has to be present for at least 10 seconds to introduce Part-time mode and absent for at least 10 seconds to delete it (i.e. re-introduce normal signal operation).

Part time may be either signals off or, for export orders, signals flashing.

See also 9.3.4(9.3.4(k)).

9.3.3(g) Local Link Inhibit (LL)

If a local link to an adjacent controller is configured an 'LL' bit may be programmed to override the link. Normally the link would then be operated by separate control bits from the computer.

9.3.3(h) Fall Back Mode (FM)

Unless the customer specifies the action of the FM bit, it will be programmed to cause the controller to disable CLF mode whilst the FM bit is true/active. Thus, if higher modes are not requested, the controller will work in the next mode below C.L.F. in the priority table, normally V.A. or F.T.

See also 9.3.4(9.3.4(g))

9.3.3(i) Take Over (TO)

A 'TO' bit may be programmed so that no 'F' bits will be effective unless 'TO' is present. The facility that is available for 'TC', desribed in section 9.3.3(9.3.3(l)), is used for 'TO' instead.

See also 9.3.4(9.3.4(n)) and 9.3.7

9.3.3(j) RTC Set to Stored Value (TS)

A 'TS' bit may be programmed to cause the time in the Real Time Clock to be set to the value stored in the configuration PROM. This is similar functionally to setting the time using CKL = 1.

The Sync signal (TS) is transmitted at the same levels as TS1 (see section 9.3.3(9.3.4(l))).

The Synch signal can set either:

a) minutes and seconds OR
b) hours, minutes and seconds OR
c) day, hours, minutes and seconds.

This will allow synching either:

a) once an hour
b) once a day
c) once a week

selected at configuration time.

9.3.3(k) RTC Synchronisation (TS1)

A 'TS1' bit may be programmed to cause the master time clock to be synchronised at 8, 18, 28, 38, 48 or 58 minutes past each hour. The synchronisation code is transmitted at 0101 levels, each level of 1 second duration.

The central office computer has to be programmed to send the synchronisation code when its system clock indicates any of the times shown below. The central office computer must be programmed such that the final "1" bit of the synchronisation code is sent on the 30 second boundary, i.e. start sending code at 27 seconds past with first '0' bit.

Hour	Minutes	Seconds
Any	8	30
Any	18	30
Any	28	30
Any	38	30
Any	48	30
Any	58	30

When the controller receives the second "1" bit (at the end of the Code), it checks to see if the real time clock is within $\pm$ 29 secs. of the synch time. If it is, the controller

sets the seconds to 30 (and the sub-seconds counter to 0). The hour is disregarded by the controller check.

Example

If the synch code is sent at (HRS:MINS:SECS) XX:08:30 and Real time clock is between XX:08:01 and XX:08:59, it will be re-synchronised to XX:08:30.

...where 'XX' is any hour.

(N.B. As the real time clock is unlikely to be a whole hour in error, the hour is ignored.)

If the real-time clock error is greater than ± 29 seconds, the synchronisation code is ignored and synchronisation confirm ('CC1') is not returned.

See also 9.3.4(9.3.4(m)).

9.3.3(l) Transmission Confirm (TC)

'TC' is an OTU output and not a transmitted control bit. Its presence indicates that valid transmission is being received from the central computer.

The controller may be programmed so that no control bits are effective unless 'TC' is present.

See also 9.3.7.

9.3.4 Reply Bits

See Figure 21.14.

9.3.4(a) Stage Confirm (G1,G2 etc.)

A single 'G' bit is returned when the specified stage is active, i.e. all fixed phases within the stage are at green (see section 2.3).

If required, the controller can be programmed so that more than one stage returns the same 'G' bit whenever the different stages are active. In this case the 'G' bit will not stay active during any interstages between two stages with the same 'G' bit unless the controller is specifically programmed to do so. (See section 9.3.3).

Two 'G' bits returned simultaneously, normally 'G1/G2', may be programmed to indicate any of the following conditions:

(i) Manual mode selected and operative.
(ii) Manual mode selected.
(iii) No lamp power.
(iv) Detector Fault Monitor timed out.
(v) NORMAL mode select button not selected, i.e. MANUAL, FIXED TIME or V/A.
(vi) An entry in the controller fault log.

When ‘G1/G2’ is received at the central office the computer releases control immediately. When ‘G1/G2’ stops being sent the computer will not regain control until reset by the operator.

Normally ‘G1/G2’ is used to indicate no lamp power, i.e. condition (iii). If it is used to indicate condition (i), (ii) or (v) then the modes that are selected may not be a higher priority than UTC and would cause the computer to release control unnecessarily and then require computer operator intervention to restore UTC control.

Ideally conditions (i), (ii) and (v) should be used with an ‘MC’ or ‘RR’ bit, condition (iv) with a ‘DF’ bit and condition (vi) with a ‘CF’ bit, although the availability of bit allocation will be the deciding factor.

If stage 2 is not used during UTC mode or there is no ‘G2’ bit, then another ‘G’ bit may be programmed to be returned along with ‘G1’.

Figure 21.15 indicates where to request the conditions required.
In the example shown, ‘G1/G2’ is returned when there is no lamp power.

See also 9.3.3(9.3.3(b)).

9.3.4(b) Detector Fault (DF)

A ‘DF’ bit may be returned to indicate any of the following conditions:

(i) Manual mode selected and operative
(ii) Manual mode selected
(iii) No lamp power
(iv) Detector Fault Monitor timed out.
(v) NORMAL mode select button not selected, i.e. MANUAL, FIXED TIME or V/A.
(vi) An entry in the controller fault log.

Normally ‘DF’ is used to indicate condition (iv) although sometimes it is used for condition (vi).

Figure 21.15 indicates where to request the conditions required.In the example shown, ‘DF’ is returned when there is a detector fault, i.e. the DFM has timed out.

9.3.4(c) Switch Facility Confirm (SC1 and SC2)

An ‘SC’ bit may be returned to indicate that its associated ‘S’ control bit has introduced its facility of the Event Timetable.

See also 9.3.3(9.3.3(c)).

9.3.4(d) First Group Confirm (GR1)

A ‘GR1’ bit may be returned to indicate that the first group, i.e. Group O, of the current CLF plan is active, regardless of whether CLF is the current mode or not.

9.3.4(e) CLF Group Synchronisation Confirm (CS)

A 'CS' bit may be returned to confirm synchronisation of the current CLF plan and cycle time to the start of the first group i.e. Group O.

The 'CS' bit is maintained for a preset period, configurable in 1 sec. steps normally set to 3 secs.

See also 9.3.3(9.3.3(e)).

9.3.4(f) Stage Demand Confirm (SD1,SD2 etc.)

A 'SD' bit may be returned to indicate the presence of a demand, either locally or from a 'D' bit, for a phase within the specified demand dependent stage.

Any phase that appears in more than one demand dependent stage will cause a 'SD' bit for each of the stages to be returned whenever a demand is present, unless the demand has been programmed to be ignored.

See also 9.3.3(9.3.3(a)).

9.3.4(g) Fall Back Confirm (FC)

An 'FC' bit may be returned to indicate that an 'FM' control bit has been received.

See also 9.3.3(9.3.3(h)).

9.3.4(h) Hurry Call Confirm (HC)

An 'HC' bit may be returned to indicate that a Hurry Call is being actioned.

9.3.4(i) Manual Control Mode (MC) and Remote Reconnect (RR)

Either an 'MC' or an 'RR' bit may be returned to indicate any of the following conditions:

(i) Manual mode selected and operative.
(ii) Manual mode selected.
(iii) No lamp power.
(iv) Detector Fault Monitor timed out.
(v) NORMAL mode select button not selected, i.e. MANUAL, FIXED TIME or V/A.
(vi) An entry in the controller fault log.

When 'MC' or 'RR' is received at the central office the computer releases control. When 'MC' or 'RR' stop being sent the computer will regain control without having to be reset by the operator as with 'G1/G2'.

Normally 'MC' or 'RR' are used to request the computer to release control or to inform it that the controller has adopted a higher priority mode by selection, i.e. Manual, Fixed Time or Vehicle Actuated. Therefore 'MC' or 'RR' are normally used to indicate conditions (i), (ii) or (v).

Figure 21.15 indicates where to request the conditions required. In the example shown, 'RR' is returned when Manual mode is selected. Tying in with the intersection in section 21 and Figure 21.8, Manual mode is a lower priority than UTC mode. The 'RR' bit is used to request the computer to release control so that the controller may be operated manually. When NORMAL is selected on the mode buttons 'RR' will stop being sent and the computer will automatically regain control.

9.3.4(j) Controller Fault (CF)

A 'CF' bit may be returned to indicate any of the following conditions:

(i) No lamp power
(ii) An entry in the controller fault log
(iii) Detector Fault monitor timed out

Figure 21.15 indicates where to request the conditions required. In the example shown 'CF' is returned when there is a controller fault, i.e. an entry in the controller fault log.

9.3.4(k) Lamps Off (LE)

An 'LE' reply bit may be returned to indicate that an 'LO' control bit to introduce Part-time mode has been actioned.

See also 9.3.3(9.3.3(f)).

9.3.4(l) RTC Synchronisation Confirm to Stored Value (CC)

A 'CC' reply bit may be returned to indicate Real Time Clock load signal (TS) has been received and actioned. The signal is maintained for a preset period, configurable in 1 sec. steps but normally set to 3 secs.

Another reply bit 'RT' may be returned at a specified time configured within the controller. When this time is reached the reply bit is activated for a preset period, configurable in 1 sec steps but normally set to 3 secs.

See also 9.3.3(9.3.3(j)).

9.3.4(m) RTC Synchronisation Confirm (CC1)

A 'CC1' reply bit may be returned to confirm the synchronisation of the RTC. The signal is maintained for a preset period, configurable in 1 sec. steps but normally set to 3 secs.

If the error at synchronisation is greater than $\pm$29 seconds, no synchronisation confirm is returned.

See also 9.3.3(9.3.3(k)).

9.3.4(n) Take Over Confirm (TOR)

A 'TOR' reply bit may be returned to indicate that UTC mode is active.

See also 9.3.3(9.3.3(i)).

9.3.4(o) Solar Override Confirm (SC)

An 'SC' reply bit may be returned to indicate that the signals are in the BRIGHT condition. This may be from either of the following sources:

(i) the solar cell
(ii) the dim override switch on the manual panel
(iii) the 'SO' control bit being active

See also 9.3.3(9.3.3(d)).

9.3.4(p) Test Facility (TF)

A 'TF' reply bit may be returned to indicate that the handset has been plugged in.

9.3.4(q) Signals Flashing (FR)

A 'FR' bit may be returned to indicate Signals Flashing

9.3.4(r) Local Link Inhibit (LC)

An 'LC' bit may be returned to indicate that the Local Link is inhibited.

9.3.5 Special UTC Requirements

Special UTC requirements that can be programmed may include the following:

(a) One 'G' bit for more than one stage. Normally the 'G' bit does not stay active during the interstage between the stages. If this is required, then a dummy phase is allocated to all the stages that are to return the 'G' bit.

The dummy phase will then remain active during the interstages and is programmed to return the 'G' bit instead of the stages active.

(b) UTC mode active disables selection of VA or Fixed Time mode.

(c) Fixed Time mode or Manual mode active returns 'G1/G2' and the current 'G' bit.

(d) Special stage change conditions. See Figure 21.21.

9.3.6 OTU Links

The OTU in the Type 400 Controller may also control and monitor an adjacent controller over a cabled link.

If the controller is a Pelican Controller, the control and reply bits will differ to those in an Intersection Controller. The control and reply bits specifically for a Pelican Controller are as follows:

9.3.6(a) Control Bits

(a) Pedestrian Demand (PX)

A ‘PX’ bit simulates a pedestrian demand.

(b) Hold Vehicle Stage (PV)

A ‘PV’ bit holds the vehicle stage and inhibits the serving of pedestrian demands. Any pedestrian demands inserted during this period will be served when the ‘PV’ bit is removed.

9.3.6(b) Reply Bits

(a) Pedestrian Reply (GX)

A ‘GX’ bit may be returned to indicate that the vehicle stage is at green.

9.3.7 Methods of Control

There are two options which govern the method of control depending on which Department of Transport Specification is to be met:

- Option 1, i.e. MCE 0105/0106

- Option 2, i.e. TCD 316

Figure 21.14 indicates where to specify the option required.

The following is a summary of the stage movements for each option. For a fuller description the relevant specification should be consulted.

Option 1

Under Option 1, a stage change will not occur unless the ‘F’ bit for the current stage is lifted and there is an ‘F’ bit (with a demand if necessary) for the next stage.

Option 2

Under Option 2, all stages are demand and extension dependent. A stage change will not occur unless there are no extensions for the current stage or the ‘F’ bit is lifted and there is a demand for the next stage with or without an ‘F’ bit.

9.3.8 UTC Mode Conditions

See Figure 21.14.

Any one of three conditions may be used to indicate UTC control:

(i) Force bits present - any one of the ‘F’ bits present.
(ii) Force bits and TC/TO present - any one of the ‘F’ bits and ‘TC’ or ‘TO’ present.
(iii) TC/TO present - any control bit and ‘TC’ or ‘TO’ present.

The above conditions may not cause UTC mode to become the current mode due to the mode priority structure. UTC may be active without being the current mode and certain control bits may have an influence in the current mode.

Conditions (i) or (ii) will cause the UTC ACTIVE indicator on the manual panel to be illuminated.

9.3.9 Outstation Transmission Units (OTU)

See Figure 21.14.

Some UTC systems require all control and reply signals to be inverted by an interposing unit.

9.3.10 The Effects of U.T.C. Control Bits on C.L.F. and Master Time Clock

The master time clock introduces C.L.F. Plans dependent upon the entries in its timetable. The method of Plan introduction may be either of two options.

MASTER TIME CLOCK (REAL TIME CLOCK) - - - - - - - - - - - - - - - - - -> C.L.F. CABLELESS LINK FACILITY

UTC bits which affect MTC

TS: Resets Real Time Clock to a configured value, e.g. 1.00 a.m.

OR

TS1: Resets real time clock to time and 30 seconds if within ±29 seconds of time when synch received. Synch is only applicable at the following minutes past the hour: 8, 18, 28, 38, 48, 58.

UTC bits which affect C.L.F.

SG: Resets CLF. Plan to start of Group 0

(N.B. This bit must not be used in conjunction with the 2nd option for plan introduction otherwise synchronisation may be upset.)

9.3.10(a) Options

Option 1

When the timetable introduces the plan, the plan always starts at Group 0.

Option 2

When a plan is introduced the controller calculates what group should be running based upon the Plan being introduced at 2.00 am and the time elapsed between 2.00

am and the real Introduction time of the Plan. The controller then brings the C.L.F. plan into synchronisation based upon this.

(N.B. It may take up to 3 cycles of a plan to achieve synchronisation, and plans must be carefully constructed to ensure synchronisation can be achieved.)

Thus, if all controllers in an area are configured as this Option, they will always remain in synch with each other regardless of when a plan is actually introduced because everything is based on a theoretical introduction time of 2.00 am.

(See also 9.9.8 for further details.)

9.3.11 UTC Parallel Stage Streaming Facilities

UTC mode can be active on any or all of the streams. If there are force bits present on any stream then the UTC active lamp will illuminate on the manual panel. Each stream can respond to its force bits independently of the other streams. If, however, it is required to have Master-Master UTC Linking, i.e. for UTC mode to operate on any stream, force bits are required to be present for all streams, then the UTC mode may be disabled on the relevant streams by Special Conditioning until the correct force bits are available.

9.4 PRIORITY AND EMERGENCY VEHICLE MODE

Priority and Emergency Vehicle modes provide a facility in which appropriate vehicles have priority in gaining and holding ROW over other vehicles.

Selective Vehicle Detectors (SVD) or transponder interrogators which respond only to the appropriate type of vehicle, i.e. buses (or Light rail vehicles if light rail transit system) for Priority mode and ambulances or fire appliances for Emergency Vehicle mode, are used to distinguish the vehicles.

The output from the SVD or interrogator is used to insert a VA demand for the Priority Phase and also provides an input for the associated Priority Unit.

The VA demand ensures that the phase gains ROW if the Priority Unit is inhibited and also starts maximum green timers, VA as well as priority.

The input into the Priority Unit is converted into a Priority Demand for a specified Priority Phase.

The presence of a Priority Demand will cause Priority or Emergency Vehicle mode to become operational, subject to mode priority considerations. ROW will then go immediately to the Priority Phase, subject to any delay caused by minimum green or intergreen periods timing off. Any VA extensions will be curtailed and any VA demands will be skipped.

Further outputs from the SVD while the Priority Phase has ROW will be converted by the Priority Unit into Priority Extensions. The Priority Extensions will hold the Priority Phase at ROW.

During Priority mode only:

(a) Any phases that have their VA extensions curtailed or their VA demands skipped may be compensated next time they have ROW.

(b) Following the actioning of a Priority Demand, that demand and/or other Priority Demands may be inhibited for a specified period. The timer relationships are indicated by the figure in Section 9.13 of this document.

9.4.1 Definitions

Detection equipment designed to respond only to the appropriate type of vehicle unit to D.Tp. Specification MCE 0117 or SPCL Specification 667/YA/17360 for buses and MCE 0123 for emergency vehicles.

9.4.1(a) Priority Phase

A phase which is equipped with emergency vehicle and/or bus priority facilities.

9.4.1(b) Priority Extension

A continuation of a green signal requested by vehicle(s) equipped to operate the priority vehicle detection equipment.
The timing range is 0 to 31.8 seconds in 0.2 second steps.

9.4.1(c) Priority Maximum Running Period

A further maximum running period which commences at the expiry of the normal maximum running period if a priority extension period is running or if a priority vehicle detector output is present.
The timing range is 0 to 255 seconds in 1 second steps.

9.4.1(d) Priority Demand

A demand for an immediate right of way originating from vehicle(s) equipped to operate the priority vehicle detection equipment.

9.4.1(e) Revertive Priority Demand

A priority demand entered, at the termination of a priority phase, for the phase being left.

9.4.1(f) Priority Change

A signal change which occurs as a result of a priority demand (the signal change being subject to the maximum safety periods and to the priority facilities specified on the phase which has right of way).

9.4.1(g) Priority Unit

A Priority Unit can be regarded as a Priority Channel. The required phase is allocated to a Priority Unit. The phase can then be regarded as a Priority Phase. The Priority facilities, e.g. Priority Timings, or Priority Inhibits are set (via the configuration Prom or the handset) for each Priority Unit. This in practice then affects the times, etc. associated with the Priority Phase.

9.4.1(h) Priority Delay

A Priority Delay can be applied to a Priority Input such that, when the Priority Input goes active, it does not apply a Priority demand on the controller until the Priority Delay Timer has expired.

9.4.1(i) Inhibit Period

A period following a priority change, during which priority changes originating from the same priority unit shall not occur, but priority extensions may still be served. The inhibit period may be considered to have started from either the commencement or end of the prior stage which was called by a priority demand.
The Priority Inhibit Period may be in the range 0 to 255 seconds in 1 second steps.

9.4.1(j) Compensation Period

An extension of the normal maximum running periods which, following a priority change may be introduced in nominated signal phases associated with each bus priority phase other than the phase to which the priority change was made.
The timing range is 0 to 255 seconds in 1 second steps.

9.4.2 Operational Description

9.4.2(a) General

Under no circumstances will the introduction or cancellation of priority facilities override the normal minimum green period, intergreen periods (including pedestrian blackout periods) or any enforced stage sequences specified for safety or other reasons. A priority demand will result in each phase in such a sequence running for its minimum period.

The priority extension priority maximum running period and priority change facilities will be provided for emergency vehicles. Inhibit and compensation periods are not required for emergency vehicle priorities.

The duration of the priority extension and priority maximum periods at the bus priority level, may not necessarily be of the same duration as those specified for the emergency vehicle priority level.

The range of priority facilities specified for a given signal phase at a particular priority level, need not be duplicated at the other priority level, nor need priority demands and priority extensions at one level apply to the same phase.

An operation of the priority vehicle detection equipment whilst the priority phase does not have right of way will, in addition to registering as priority demand, register as a normal demand. If the phase is normally called by a call/cancel unit, a latching demand may still be registered.

Provision is made for the full range of priority facilities for buses, but the inclusion of certain facilities is optional and some facilities are interdependent.

The minimum facilities for buses are priority extension and priority maximum running period.

Priority change may be added. An on/off control may be specified to include or exclude this facility.

An inhibit period may be added.

Compensation period(s) for phases curtailed or omitted may be added.

Priority facilities for emergency vehicles and for buses will only need to be provided on a maximum of two phases for each priority level at a junction. The priority phases for emergency vehicles need not be the same as the priority phases for buses.

9.4.2(b) Precedence Levels

For isolated operation, the normal order of precedence for the differing levels of priority (in descending order) shall be:

Emergency Vehicle
Hurry Call
UTC
Manual
Manually Selected other modes
CLF
Buses
VA
FT

9.4.2(c) Servicing of Priority Facilities at a Common Priority Level

The presence of an output from a priority vehicle detector will, while the priority phase is running, hold the green signal. The cessation of the output will initiate a priority extension period. A priority demand, for a phase other than that which is running, which is received whilst a priority extension and/or priority maximum period is running at the same priority level, will be stored and serviced when the proper extension or priority maximum period expires, when no inhibit period is specified.

The priority extension period, for buses or for emergency vehicles will be adjustable by means of switch(es) or other approved means over the range 0 to 15 seconds, in one second steps.

The priority maximum running period for buses will be adjustable by means of switch(es) or other approved means over the range 0 to 36 seconds, preferably in 1 second steps, otherwise in not more than 4 second steps.

Should two or more priority demands be stored at the termination of a minimum running period, then the priority demands will be serviced in the normal cyclic order and not necessarily in order of receipt. An exception may be made for LRVs (see section 9.4.6(a)).

When a priority extension runs a phase beyond its normal maximum running period, then a normal demand will be entered upon leaving the phase during, or at the end of, the priority maximum running period. An extended intergreen will also be introduced in this case if specified for the intergreen period following the state (for high speed roads) or the maximum value of a variable intergreen will be introduced. This demand and extended intergreen may be omitted only if, by monitoring of normal detectors, it is established that no vehicles or vehicle extensions are present at the end of the phase.

If a phase terminates with a Priority Extension asserted, then a revertive priority demand will be automatically entered, if the priority demand facility is specified. Optionally, a switch may be specified to enable this reversion to be included or excluded. This reversion shall not be included for the emergency vehicle priority level.

When the inhibit period is not specified, then irrespective of the normal cyclic stage sequence, priority demands which are received after the commencement of a priority change, will be serviced in cyclic order based upon the priority demands and after any priority extensions (subject to the priority maximum running period) are satisfied. An exception may be made for LRVs - see Section 9.4.6(a).

An inhibit period will only be introduced when a priority change has lead to a running phase being prematurely terminated or a demanded phase has been omitted.

In the case of a controller having 5 or more stages, the inhibit period may be introduced following any priority change, irrespective of curtailment or omission of a stage.

The inhibit period will be terminated either after a pre-selected period has elapsed, which period shall be adjustable by means of a switch(es) or other approved means over the range 30 to 150 seconds in not more than 10 second steps, or by right of way being granted to the priority phase whichever occurs first.

A priority demand stored during the inhibit period will be cancelled if the demanded phase is served at the normal VA level during the inhibit period (this will also cancel the inhibit period).

A preselected extension (the compensation period) to the normal maximum running period will, when specified, be given to nominated phases the first time they run following a priority change, if they were curtailed or omitted by the priority change. The compensation periods will be adjustable over the range 0 to 30 seconds, in not more than 2 second steps, selected individually for each signal phase for which compensation is specified. This may alternatively be effected by switching the maximum phase running period(s), in which case the timing increments may be seconds. Different phases may be compensated as a result of priority changes to each priority phase.

In the case of a controller having 5 or more stages, the compensation period may be given following any priority change, irrespective of curtailment or omission.

If a compensation period is curtailed by a priority change, the compensation period may be reapplied on the next cycle.

If the compensation periods are required on a phase as a result of two separate priority changes, these compensation periods will run concurrently.

Each signal phase omitted or curtailed by a priority change will always be serviced in the normal cyclic order following a priority change.

The receipt of a priority extension request, during an inhibit period, for a running priority phase will result in a priority extension and priority max running period being introduced.

A compensation period will only be introduced on a particular running phase if there is an outstanding vehicle extension present at the expiry of the normal maximum period for that phase.

When a priority change results in a VA extension being curtailed, then:

For high speed roads, an extended intergreen period will be introduced if specified for that stage change.

A revertive demand will be entered for the phase being left.

In the event of a bus detector:

(a) having a fault indication occasioned by disconnection of the loop

(b) giving a permanent output for 5 minutes

then the output of that detector will, until manually reset, have no further effect on the operation of the controller, and the external DFM lamp will be illuminated.

Should the emergency vehicle detector give an output, with no interruption exceeding either 4 or 8 seconds as selected, for a period in the range 30 to 240 seconds in steps of 30 seconds or less (selected by switch(es) or other approved means) then the effect of that detector output, and of any other emergency vehicle detector operating on the same phase, will be inhibited until there has been a break in the output for the 4 or 8 second period above, at which time the detector outputs will be re-enabled.

9.4.2(d) Changes from A Lower to a Higher Priority Level

Changes from a lower priority level to a higher priority level (i.e. normal to bus or bus to emergency vehicle) can only occur on receipt of a priority demand for a higher priority level than that which is running, or a priority extension of a higher priority level occurs on a phase which is in progress.

Emergency vehicle priority demands and/or extensions which are received whilst an inhibit period on the bus priority level is running, will be serviced immediately, subject to normal safety periods.

On a change from the bus priority level to the emergency vehicle priority level, all stored priority demands for phases, inhibit and compensation periods, at the bus priority level may be cancelled. Normal VA demands will be stored as usual.

Should an emergency vehicle priority extension request be received for the running phase whilst a bus priority extension period is running, and before the expiry of the normal maximum running period, then the priority maximum period for the emergency vehicle priority level will commence from the expiry of the normal maximum running period. However, should the emergency vehicle priority extension request be received after the commencement of the bus priority maximum period, then the emergency vehicle priority maximum running period will commence from the receipt of the emergency vehicle level priority extension.

When a priority change from the bus priority level to the emergency vehicle priority level results in a bus priority extension being curtailed, then an extended intergreen period will be introduced if specified for that stage change (for high speed roads) or the maximum value of a variable intergreen will be introduced.

9.4.2(e) Changes from Emergency Vehicle to Bus Priority Level

When all the conditions and requirements pertaining to the emergency vehicle priority facilities have been serviced, the controller will return to normal (VA) operation or to bus level if bus demands have been stored. Bus demands need not be stored during emergency vehicle priority working. Bus demands/extensions, subsequent to the return to normal operation, will be serviced in the normal way.

If the change from the emergency vehicle priority level occurs part way through a phase and before the normal maximum running period has expired, then the subsequent receipt of a bus priority extension request on the running phase will introduce a bus priority extension and priority maximum running period.

If a change from the emergency vehicle priority level occurs after the normal maximum running period has expired, a maximum signal change to the next demanded stage in the cyclic sequence will then occur, unless a bus extension is present or a bus demand stored for another phase.

9.4.2(f) Other Changes of Level

If a controller is “taken over” by UTC force signal(s) while a priority level is running, the force signal(s) will have no effect until all vehicle extensions at the priority level have been satisfied. Subsequently, response to force signals will comply with specification MCE 0106, unless further priority demands and/or extensions are received.

If a controller is “taken over” while the bus priority level is running, and the input defined in section 6.3 is present, then the controller operation will comply with specification MCE 0106.

Note: Mode priorities will be in accordance with Works Specification, however Emergency vehicle priority operation will normally override UTC input (see section 9.4.2) and Bus priority will override VA.

9.4.2(g) Tolerances of Timers

Tolerance will be in line with the relevant Sections of MCE 0141.

9.4.3 Basic Facilities

Reference should be made to Figure 21.16.

Both Priority and Emergency Vehicle modes have the same facilities unless otherwise stated.

9.4.3(a) Priority Units

There are 8 Priority Units (0 to 7) available which may be divided in any proportion between Priority and Emergency Vehicle Mode.

If both modes are used then the following conditions are applied:

(i) The Priority Units are allocated to Priority mode first.

(ii) Emergency Vehicle mode is higher than Priority mode in the mode priority table.

9.4.3(b) Priority Phase

Each Priority Unit is allocated a Priority Phase which may either be a real phase or dummy phase. The Priority Phase may either be in general use or used only for the priority facility.

9.4.3(c) Priority Demand

A Priority Demand for a Priority Phase is either created by its Priority Unit from an SVD input or from the Revertive Priority Demand facility. The priority input may also be used to generate a V.A. demand for the same phase such that if Priority mode is unavailable for any reason the phase will still be serviced.

(N.B. Both priority demands and associated VA demands are latched. An Unlatched facility may be achieved by use of special conditioning, see Configurator handbook for further details on conditioning libraries.)

If a Priority Demand is not required, it may be disabled so that only Priority Extensions are created. This does mean that (although not Priority demanded), when the associated Priority phase reaches green, the controller will switch to Priority mode as Priority extensions are present and the Priority maximum timer will time off as normal.

If Priority mode is disabled, the associated VA demands will still be entered and serviced, and if the standard facility which is latched Priority demands is used, the Priority demands will be stored up until Priority mode is available again.

9.4.3(d) Revertive Priority Demand

When a Priority Phase terminates with a Priority Extension active, a Revertive Priority Demand is inserted for that Priority Phase, providing the Priority Demand facility has not been disabled.

If the Revertive Priority Demand facility is not required, it may be disabled without affecting the Priority Demand facility.

9.4.3(e) Priority Units Inhibited (Priority Mode Only)

When a Priority Phase gains ROW, it is possible to inhibit specified Priority Units (including the one at ROW) for a specified time.

9.4.3(f) Revertive Priority Demands To Start Inhibit Timer (Priority Mode Only)

This facility allows the Priority Units inhibited facility to be activated when a Priority Phase gains ROW due to a Revertive Priority Demand being present.

9.4.3(g) Allowed VA Demands For Phases

When a Priority Demand is being actioned all VA demands are normally disregarded until after Priority or Emergency Vehicle mode have finished.

However, it is possible to specify phases, which appear cyclically before the Priority phase, which may have any VA demands present to be actioned before the Priority Demand.

The specified phases will only run for their minimum green period regardless of any VA extensions present.

If the Priority Phase is a pedestrian phase, Allowed VA Demands should not be used.

(N.B. This facility is not compatible with priority phases of type 2 appearance, i.e. if the stage in which the priority phase appears is active when a priority demand is received, the priority phase appears immediately. At the same time unwanted “enforced VA demands” may be entered, which may cause unnecessary timing of priority maximum and unnecessary stage changes when the priority phase terminates.)

9.4.3(h) Enforce VA Demands For Phases

This facility works on the same basis as Allowed VA Demands for Phases except that VA demands for the specified phases are inserted to ensure that the specified phases will run.

(N.B. This facility is not compatible with priority phases of type 2 appearance, i.e. if the stage in which the priority phase appears is active when a priority demand is received, the priority phase appears immediately. At the same time unwanted “enforced VA demands” are entered, which may cause unnecessary timing of priority maximum and unnecessary stage changes when the priority phase terminates.)

9.4.3(i) Monitor Time

The SVD’s may not operate for long periods due to their normal use and so are not considered for the Detector Fault Monitor (DFM). (See section 15.9).

In order to monitor the input to a Priority Unit, a Monitor Timer is used. The operation of the Monitor Timer is different when in Priority mode to that in Emergency Vehicle mode.

(1) Priority Mode Fault Monitor

When the input becomes active the Monitor Timer is started. When the input becomes inactive the Monitor Timer is reset providing it has not timed off. If it has, i.e. the input has been active for an abnormal amount of time, then the Priority Unit is disabled. A fault is then recorded against the Priority Unit and the Cabinet Alarm is illuminated.

If the input now becomes inactive, one way of re-enabling the Priority Unit is to reset the DFM. This is achieved by either pressing the DFM Reset button on the manual panel or by using the DFM Reset Command on the handset. The fault log entry will not be reset.

The other way of re-enabling the Priority Unit is to use the Bus DFM Self Reset facility.

(2) Emergency Vehicle Mode Fault Monitor

When the input becomes active the Monitor Timer is started. When the input becomes inactive the Monitor Timer stops but is not reset unless the input is inactive for a specified period - the Emergency Gap Time.

If the input becomes active again within the Emergency Gap Time then the Monitor Timer will continue to time. If the Monitor Timer times off, i.e. the input has been active for an abnormal amount of time, then the Priority Unit is disabled.

The Priority Unit will be re-enabled by the input becoming inactive for the Emergency Gap Time. The fault log entry will not be reset.

The timing range of the Monitor Timer is 0 to 2550 seconds in 10 second steps.

9.4.3(j) Priority DFM Self Reset Facility (Priority Mode Only)

This facility allows a disabled Priority Unit to be re-enabled by the associated input becoming inactive. The fault log entry will not be reset.

9.4.3(k) Emergency Gap Time (Emergency Vehicle Mode Only)

The Emergency Gap Timer is started by an input becoming inactive and is reset by the input becoming active.

A disabled Priority Unit will be re-enabled if the input is inactive for the Emergency Gap Time. The fault log entry will not be reset.

The timing range is 0 to 255 seconds in 1 second steps.

Note: the Emergency Gap Time is sometimes referred to as the Detection Interrupt Period.

9.4.3(l) Priority and Emergency Vehicle Parallel Stage Streaming Facilities

Each stream will move around its own stages according to its own Priority or Emergency Vehicle demands and extensions independent of any other streams.

9.4.4 Visual Indications

A separate indicating light emitting source is normally provided, behind the police facility door of the controller. Whilst a priority vehicle is detected, the handset may be used to determine which priority unit has been demanded.

For each priority stage equipped with an inhibit period, a display is available on the handset to indicate that an inhibit period is running.

For each priority stage equipped with a compensation period, a display is available on the handset to indicate a compensation period is running.

Note: The indicators above may alternatively be provided by the handset.

Handset facilities are provided at the controller to enable:

(a) A permanent priority demand to be inserted.

(b) The priority facility to be permanently disabled.

(c) Insertion of a priority demand pulse.

9.4.5 Interfaces

For controllers modified in accordance with MCE 0106, inputs and outputs to the OTU will be provided as in 6.3 and 6.4. These will comply with the requirements of MCE 0106 Section C7 and C8 respectively.

For controllers used in linked systems, and output as in section 9.4.4 will be provided.

9.4.5(a) Inputs

Optionally, an input may be provided such that Condition ‘0’ will cause the bus priority facilities to be isolated. Bus priority demands need not be stored. The input will take effect irrespective of the state of computer control force bits.

9.4.5(b) Outputs

An output channel will be provided to indicate that stage confirmation signals may not be as required by the computer/linking plan. Condition ‘0’ will be returned to indicate that the controller is operating at a priority level (either bus or emergency vehicle).

A separate output channel for each bus priority stage may be specified. Condition ‘0’ will be returned to indicate the presence of a bus demand or extension.

A separate output channel for each emergency vehicle priority phase may be specified. Condition ‘0’ will be returned to indicate the operation of an emergency vehicle detector. (This may be used to synchronise a “green wave”).

9.4.6 Use of Priority Mode for Control in Light Rail Transit Systems

Shown in Figure 9.2 is a block diagram of the additional features available in Priority mode which may be used when controlling Light Rail Vehicles.

9.4.6(a) Serving Priority Demands in Order of Receipt

In general the controller will serve the Priority Demands cyclically. On receipt of one or more Priority Demands the controller will move to the next stage cyclically which serves a demanded Priority Phase. If another stage further round the cycle can serve this Priority Phase and another Priority Phase, then the controller will move there instead. This is the same movement strategy as used in VA.

However, when using Priority Mode with a LRT System, in deciding which Priority Demand the controller will serve next, the controller needs to take into account that one LRV approach may be used by 2 LRV's which turn in different directions at the intersection.

When a signal is received indicating that the LRV Request for Unit 0 is active, a decision has to be made as to whether this Unit is one of a pair requesting ROW on the same approach, which must therefore be served in order of receipt relative to each other or are not the same approach and can therefore be served cyclically. The information specifying which LRV units have to be treated as pairs is entered at configuration "associated priority unit" see Figure 21.7 "Associated Priority Unit" column. Figure 9.2 assumes that Unit 1 is associated with Unit 0.

When the LRV Request for Unit 0 goes active, the state of the LRV request for Unit 1 is tested and if this is not active, then Unit 0 will be enabled, such that when its First Priority Delay timer has expired, it will set a flag readable by Special Conditioning.

This flag can be used to inhibit moves other than to specified stages if required during the 2nd delay period. i.e. "During Second Delay Prevent Except Stage" on the configuration sheets. (This is to enable immediate servicing of the Priority Demand after the Second Priority Delay by avoiding the controller being caught in a stage change.)

After expiry of this second delay timer, the request gets passed to special conditioning ('B') provided that Unit 0 request is enabled by the "first come first served logic", i.e. provided that a request for Unit 0 is not already present. If a request for Unit 1 is already present, then the request for Unit 0 is stopped until the request for Unit 1 clears. If the request for Unit 0 clears before 1 clears, then the request for Unit 0 is ignored.

The Priority Inputs at 'B' are inputs to the special Conditioning. The outputs from the Special Conditioning are shown at point 'C'. The Special Conditioning outputs 'C' connect to the inputs of the Vehicle Priority Software. If the Priority signal does not require conditioning, then point 'B' can effectively be connected directly to point 'C' without passing through Special Conditioning.
(For points B and C refer to Figure 9.2.)

9.4.6(b) Request Delays

The first delay as indicated allows for the travelling time of the LRV from the request detector to the junction. The first delay covers time which is not needed to process the LRV request. This is normally due to the detector not being in the ideal position (for instance due to an intervening stop). During the first delay, the controller takes no action on the demand. The second delay which forms the later part of the overall delay before the LRV actually reaches the junction, allows the controller to be prepared to give instant service to the LRV. This is usually done by using special conditioning to prevent any stage moves except to a stage which will serve the requested LRT phase. See Figure 22.11 “During Second Delay Prevent Except Stage” column. This ensures that the required stage move does not get held by other stage changes or have to wait for other minimum green times to expire.

There are 8 sets of (1st and 2nd) delay periods (0 - 7) these are normally associated with the respective priority units 0 to 7.

However, it is possible to allocate two or more sets of delays (2 or more inputs) to one priority unit in special conditioning. See Figure 9.3.

9.4.6(c) Extend All Red Option

It is also possible to use priority demand inputs to special conditioning (see ‘B’ on Figure 9.2) to extend the all red period between stages should a priority phase terminate with a priority demand input still active. This facility provides time to ensure that the LRV clears the junction. This is again achieved using the special conditioning facility.

For further details on special conditioning libraries, see Configurator Handbook

Figure 9.2 - PRIORITY DEMAND ORDER

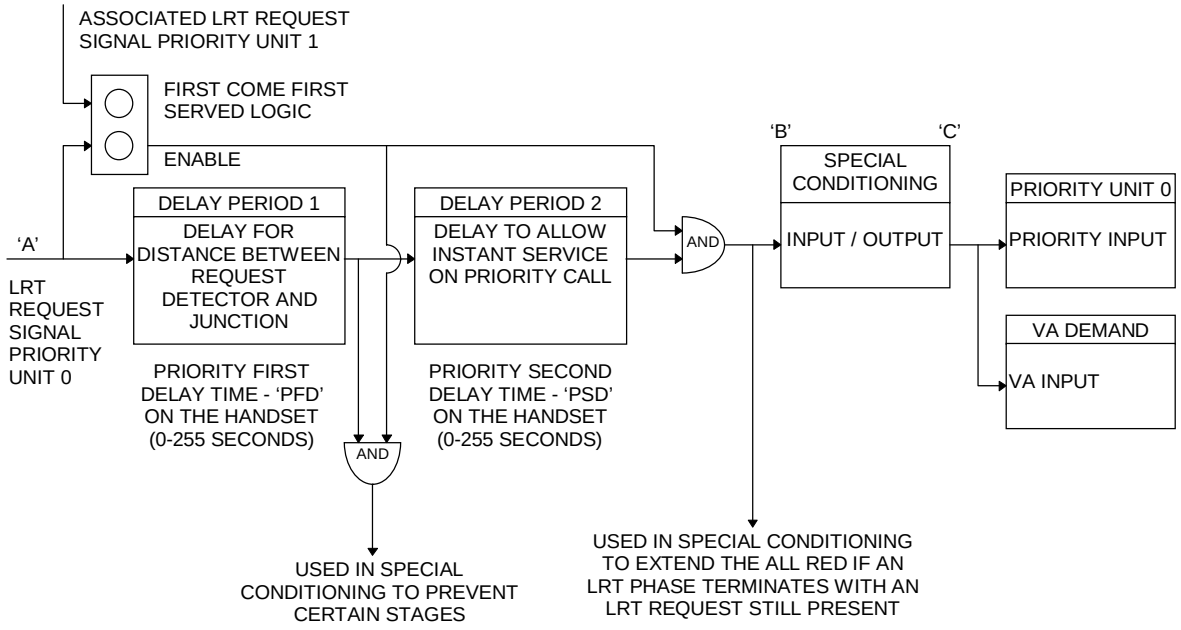
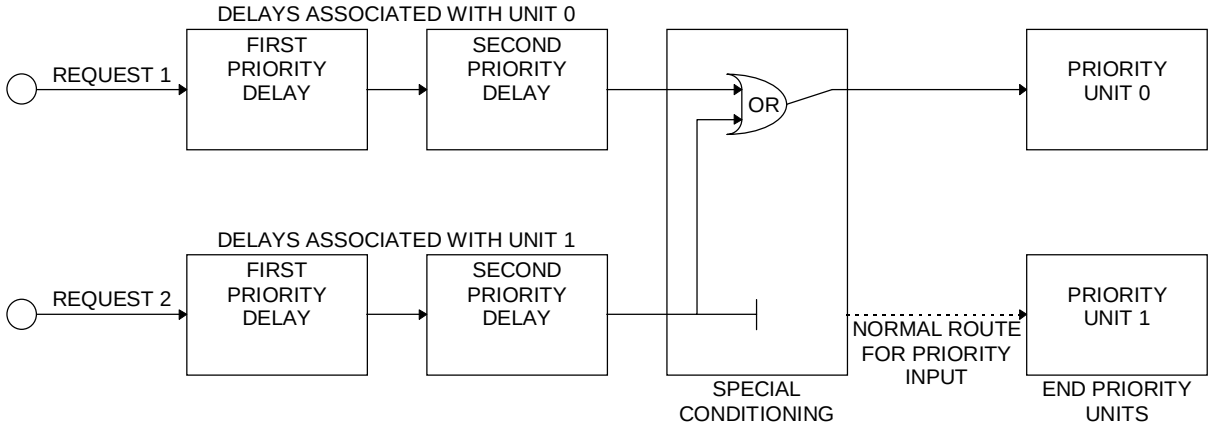

ASSOCIATED LRT REQUEST SIGNAL PRIORITY UNIT 1
FIRST COME FIRST SERVED LOGIC
ENABLE
'A'
LRT REQUEST SIGNAL PRIORITY UNIT 0
DELAY PERIOD 1
DELAY FOR DISTANCE BETWEEN REQUEST DETECTOR AND JUNCTION
PRIORITY FIRST DELAY TIME - 'PFD' ON THE HANDSET (0-255 SECONDS)
DELAY PERIOD 2
DELAY TO ALLOW INSTANT SERVICE ON PRIORITY CALL
PRIORITY SECOND DELAY TIME - 'PSD' ON THE HANDSET (0-255 SECONDS)
AND
AND
'B'
'C'
SPECIAL CONDITIONING
INPUT / OUTPUT
PRIORITY UNIT 0
PRIORITY INPUT
VA DEMAND
VA INPUT
USED IN SPECIAL CONDITIONING TO PREVENT CERTAIN STAGES
USED IN SPECIAL CONDITIONING TO EXTEND THE ALL RED IF AN LRT PHASE TERMINATES WITH AN LRT REQUEST STILL PRESENT

Figure 9.3 - TWO DELAYS SET FOR ONE PRIORITY UNIT



9.5 HURRY CALL MODE

A hurry call demand gives precedence to a particular stage to ensure that a green signal is given to certain vehicles. Hurry calls may be used at junctions, e.g. near to fire or ambulance stations, to ensure that certain vehicles are given right of way, or in conjunction with queue detectors, to prevent blocking of a junction.

Two hurry calls (0 and 1) are available. They must be allocated a higher priority than VA and Hurry Call 0 will have higher priority than Hurry Call 1. Timings associated with the hurry calls are:

(a) Hurry call delay - the period between receipt and implementation of a hurry call (DHC). The implementation of the Hurry Call is the point at which the controller accepts the hurry call request and lights the hurry active LED.

(b) Hurry call hold - the period that the hurry call stage is maintained following selection (HHC).

(c) Hurry call prevent - the period following selection of the hurry call stage during which a repeat of the same hurry call is prohibited (PHC).

(d) Hurry call request watchdog, i.e. a request for a hurry call mode persisting for longer than the request watchdog period will cause the hurry call mode to be unavailable and an entry made in the fault log. Hurry call mode will be unavailable until hurry call fault log entries are cleared.

(e) Hurry call watchdog, i.e. period for which the controller may remain in a hurry call mode. If the controller remains in hurry call mode for longer than the watchdog period, the hurry call mode will become unavailable and an entry made in the fault log. Hurry call will be unavailable until hurry call fault log entries are cleared.

(f) Hurry call call/cancel facility; Special conditioning can also provide a call cancel facility for the hurry call input, i.e. as long as the input is active, the hurry call will act as normal. However, if the input goes inactive, this is taken by special conditioning to be a cancel signal and the special conditioning then sets true the cancel input for the hurry call. If the hurry call is cancelled, the Prevent timer does not become active, so if required, this may also be implemented in special conditioning.

Facilities (d), (e) & (f) can be provided by Special Conditioning for Export only.

The programmed values may be changed via the handset using the commands in brackets. The periods for (d), (e) and prevent timer in (f) can be changed by use of the command (PIR) for relevant conditioning timer, see the Handbook for the Configurator for details of timers used, and any special conditioning libraries.

Immediately a valid hurry call is received, the HURRY ACTIVE indicator on the manual panel illuminates and remains illuminated until the end of the hold period. A

hurry call is valid provided its prevent timer is not active due to a previous hurry call and the delay timer for any higher priority hurry call is not active. A cancel input for each hurry call enables the process to be terminated any time during the delay, hold or prevent periods.

There are two hurry call units available on the controller (0 & 1), the facilities described below exist for both individual hurry call units.

The hurry call for a stage is normally generated from a remote push button or special detectors but other calling conditions can be used, if required. On receipt of a hurry call request the controller will go into Hurry Call mode after a preset delay - the hurry call delay period - providing the controller is not in a higher priority mode.

On expiry of the hurry call delay period, the controller moves immediately to the requested stage, subject to stage movement restrictions, provided the intergreen timings and minimum green timings associated with phases in the currently running stage have expired.

Extensions for running phases are ignored. If the requested move to the hurry call stage is not permitted directly, the controller can be programmed to move via the all red stage or other specified permitted stage movements to the hurry call stage. If the move is accomplished via an alternative stage(s), these stage(s) terminate when their phase minimum green timings expire. During the move to the called stage, any active intergreen extensions are implemented.

With the hurry call stage selected, the condition is held for a preset period - the hurry call hold period - irrespective of the condition of the minimum, extension and maximum green timers for phases in the stage. At the end of the hold period, the controller reverts to the highest priority mode whose operating conditions are active.

The hurry call is only considered to have been serviced when the required movement has been active for the hold period. Thus, if the movement is cut short by a higher priority mode, the request remains and is serviced after the higher priority mode unless, in the course of operating in the higher priority mode, the cancel input is activated.

The prevent timer allows programming of the minimum period between repeats of the same call. With the prevent timer for a call running, incoming calls are rejected. The prevent timer commences to time at the same time as the hold timer.

Cancel input: An input can be configured to cancel the hurry call. If the cancel input becomes active during the delay period, the controller will drop out of hurry call mode.

(N.B. If cancelled during the Hold period, the prevent timer is reset, thus the same hurry call can cause hurry mode to become active again immediately, without waiting for a prevent time to expire.)

Acknowledge/Confirm output: An output can be configured to confirm that a valid hurry call request has been received and accepted. If the request is not accepted due to any of the reasons mentioned below, the output will not become active to confirm.

The reasons for a request being rejected may be:

(i) The prevent timer being active.

(ii) The delay timer for the higher priority hurry call (0) being active,

(iii) Hurry call mode being disabled. (Perhaps by special conditioning, see (d) and (e) above.)

This output may be used to activate a switching mechanism which illuminates an indicator at the origin of the hurry call request, e.g. Fire station, or it may be used as a confirm signal for a UTC system.

9.5.1 Priority of One Hurry Call Over Another

There are two hurry call units available 0 & 1. 0 is the higher priority call. If a request for hurry call 1 occurs whilst the delay for hurry call 0 is timing the request for 1 is rejected (it is not latched in by the controller).

If a request for hurry call 0 occurs during the delay or hold period for Hurry Call 1, Hurry Call 1 is interrupted and the controller moves to serve Hurry Call 0. After serving Hurry Call 0, the controller will return to the stage requested by Hurry Call 1, and the hold period
is re-started.

Special Conditioning may be used to further enhance this priority of Hurry Call 0 over Hurry Call 1 as follows. Special Conditioning may be written to prevent the Hurry Call 1 input whilst Hurry Call 0 prevent timer is active. This may then be used to ensure a gap between hurry calls so that a controller is not unduly held up.

N.B. If the Hurry Call is inserted from a momentary pushbutton it is advisable to use a Hurry Call Confirm output in the above instances, so that the sender knows if the Hurry Call has been accepted.

9.5.2 Hurry Call Parallel Stage Streaming Facilities

Two Hurry Call units will be available, numbered 0 and 1, and they may be allocated to any stage on any stream.

If they are both allocated to different stages but in the same stream, they will be actioned on the basis of Hurry Call 0 being of higher priority than Hurry Call 1.

However, if they are allocated to stages in different streams, they can both be actioned simultaneously, neither having precedence over the other or affecting each other in any way.

9.5.3 Control From A Remote Pushbutton

If, on pressing the hurry request button, the confirm indication does not illuminate then this indicates that the request has been rejected due to either:

- The Prevent Timer being active.
- The Delay Timer for a higher priority hurry call being active.
- Hurry Call mode being disabled.
- Any Special Conditioning which prevents the input of the Hurry Call.

e.g. Prevent Hurry Call 1 input whilst prevent timer for Hurry Call 0 is active.

The fact that the HURRY ACTIVE indicator is illuminated following the request only indicates that the hurry request has been accepted and latched into the controller. The servicing of the request may be delayed because a higher priority mode is active or a higher priority hurry call is requested.

In the case where UTC mode is a higher priority than the Hurry Call mode then, on receipt of a valid hurry call request, the confirm indication will normally be transmitted to the central office for actioning (either by relinquishing UTC mode or by introducing a special hurry call plan in UTC mode).

9.5.4 Control From A Queue Detector

Normally, the signal for the queue detector is processed by a call/cancel facility. While the output of the call/cancel is active it may be required to force and hold the hurry call stage indefinitely. To achieve this, the prevent period is set to zero and the hold period is set at some small value, say five seconds. When the hold period expires, the hurry call stage is immediately requested.

When the hurry call request from the call/cancel facility goes inactive, this is taken as a cancel request and the hurry call stage is terminated. (This requires special conditioning.)

The hurry call may be interrupted by a higher priority mode and on terminating this mode the hurry call is serviced again only if it is still requested.

9.5.5 Timings Range

The range of timings for the Delay, Hold and Prevent periods is 0 to 255 seconds in 1 second steps.

9.6 SELECTED MANUAL CONTROL MODE

Refer also to Section 16.

MANUAL mode selected on the pushbuttons is recognized as a mode for priority purposes and for use during UTC mode.

Manual mode will only become operative if it is a higher priority then the current mode and if it has not been disabled.

9.6.1 Manual Mode

(If Manual Step-On facility is fitted see also section 9.7.)

With the MANUAL mode button pressed, Manual mode will be selected providing there are no operating conditions for a higher priority mode (see section 9.12). During Manual mode, only 7 stages and the all-red condition (Stage 0) are available to be selected by means of push-buttons on the manual panel. No stage changes may be made until the last phase minimum green in the current stage has timed off. When the controller is ready to accept a selection, the AWAITING COMMAND indicator illuminates and any subsequent push-button selection is implemented provided:

(i) No prohibited stage move condition is violated.
(ii) The requested stage is not deleted by the master time clock.

If any of these conditions occur, the PROHIBITED MOVE indicator illuminates. In the case of (i) the stage can be selected via another stage change which is allowed, e.g. to Stage 0, but in the case of (ii), the stage cannot be selected until the master time clock inhibit is removed. Any phases deleted by the master time clock will not be active during Manual mode. For control of non-fixed phases during Manual Control see section 3.9.

When Manual Mode ceases, demands may be automatically inserted for selected non-running phases to force a particular sequence. These demands are normally inserted to ensure no vehicles are trapped against a red light, unless otherwise requested by a customer.

9.6.2 Allocation Of Stages To Push-buttons

Stage 0 is always allocated to Push-button 0. Up to 7 of the remaining stages may be allocated to any of push-buttons 1 to 7 as required (see Figure 21.5). Stages other than those allocated to the push-buttons may appear during Manual mode. If one is active when Manual mode first becomes operative it will continue to run until a new selection is made. If one is used as alternative stage during a prohibited move, the stage will run for the minimum period and then automatically change to the required stage.

During the interstage and while the stage is active, the indicator by the push-button number that the stage is allocated to will illuminate on the manual panel. Push button numbers would normally coincide with stage numbers although this is not necessarily

so. Where parallel stage streaming is employed the indicator will illuminate when the combination of stages that is allocated to the push-button is active

9.6.3 Manual Mode Enable/Disable Facility

Manual mode may be enabled or disabled from becoming operative by two methods (see Figure 21.8 for configuration example):

i) by using the handset command MND.

If NORMAL has been selected on the mode select buttons and manual switch position is disabled using handset (MND=1) then if MANUAL is selected, the controller continues as if still in normal position.

Using handset command MND=0, manual can be enabled so switching to manual position will allow manual operation.

If the controller is under manual operation and the handset is used to disable manual mode (MND=1), then manual mode will continue until another mode select button is pressed. If MANUAL is then re-selected, the controller will continue as if NORMAL were selected.

ii) by the handset being plugged in or out when configured on a particular intersection.

If manual is selected while the handset is not plugged in then the controller will continue as if normal was selected.

If manual is selected with the handset plugged in the controller will allow manual operation until the handset is removed or until another mode select button is pressed.

9.6.4 Manual Control Parallel Stage Streaming Facilities

The Manual Stage Buttons are programmed so that each of the 7 buttons can select:

a) a combination of stages, one from each stream, that will run simultaneously,

b) one stage from any one stream

9.6.5 Dim Override facility

The Dim override push button will toggle the Dim/Bright state of the lamps if the lamps are in the dimmed state initially. SW1 will be used for this function if it is required. Auxiliary LED1 will normally be configured such that LED ON represents the overriding of the dimmed state to bright.
NOTE: **Override is from Dim to Bright only.**

9.7 MANUAL STEP-ON MODE

A Manual Step-on facility can be provided when a Police Manual Panel is fitted. See Figure 9.4.

If the Manual Step-on facility is used and located behind the Manual access flap on the side of the controller, the Manual facility described in section 9.6 is transferred to the internal manual panel.

It is possible to change stage under Manual Step-on Control by operation of a push button on the Police Manual Panel. When Manual Step-on has been selected on the Police Manual Panel, the controller, subject to the Mode Priority, will go into Manual Step-on Mode. The order in which stages are introduced in Manual Step-on is predefined in configuration (site data). The push button on the Police Manual Panel is operated to make the controller move on to the next designated stage. Having arrived at the next stage the controller may do one of two things depending on the option selected.

(a) Remain in that stage indefinitely, the controller being ready to respond to another operation of the push button, which if operated will send the controller to the next predefined stage,

or

(b) stay in one stage for a fixed period defined at configuration and then automatically move to another pre-defined stage. The controller is then ready to respond to a further push button operation.

The user may change the operation between (a) and (b) as required, by means of the handset.

There is a separate Push Button for selecting All Red. When this Push Button has been operated the controller will, subject to any safety periods, change to the All Red stage. The controller will stay in the All Red stage until the Manual Step-on Push Button is operated when the controller will move to the next stage in the cycle following the stage prior to the call to the All Red stage. Alternatively, if the manual mode is switched off the controller moves to the stage required in the new mode.

The Manual mode should be disabled after use by operating the Manual Disable pushbutton.

9.7.1 Manual Disable Switch (Police)

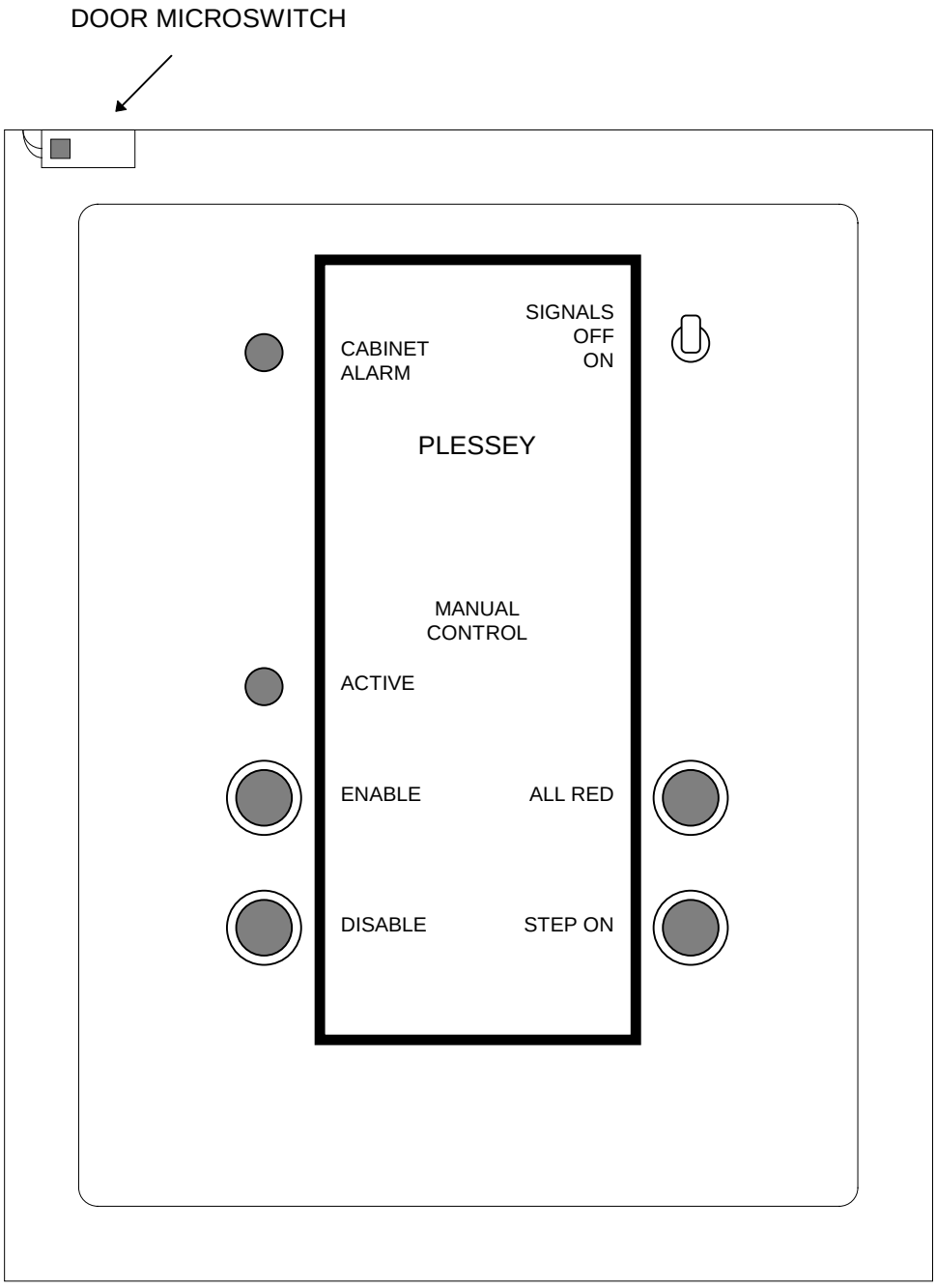
A micro-switch may also be fitted to the Police manual step-on panel to disable manual step-on mode when the door is closed. If the manual panel is subsequently opened, manual step-on mode is **not** re-entered; to select manual step-on mode it is necessary to operate the Enable push button.

9.7.2 Manual Step-on Mode Parallel Stage Streaming Facilities

Each step is allocated a combination of stages, one from each stream, that will run simultaneously.

(N.B. After selecting the mode, it may take the controller a couple of steps to become synchronised with the manual Step-on facility.)

Figure 9.4 - Police Manual Step-On Panel Layout



9.8 SELECTED FIXED TIME, CLF OR V.A. MODE

Manually selected 'FT', 'CLF' and 'VA' are selected by mode select buttons 'FIXED TIME', 'CLF' and 'V.A.'. The modes selected are recognised as modes for priority purposes and for use during UTC mode.

The respective mode will only become operative if SELECTED FIXED TIME, CLF or VA mode is a higher priority than the current mode.

These mode select buttons may be used to force the controller to work in VA, CLF or FT mode rather than in a mode (UTC, Priority, etc.) which would normally be higher in priority than VA, CLF or FT. Because although VA or FT is usually configured as the lowest priority mode, SELECTED VA/FT/CLF is treated as a separate mode, and can be configured higher up in the mode priority table.

(N.B. Priority demands and associated VA demands are latched and will affect the operation if VA is selected. However Priority mode will not become operative and Priority maximums will not take effect.)

9.9 CABLELESS LINKING FACILITY (CLF) MODE

The cableless linking facility (CLF) allows a method of linking traffic intersections along a route and/or in an area using timing information derived from the master time clock system (MTCS) in their controllers. Different Plans are used during the day to cater for varying traffic patterns.

CLF consists of Plans which are made up of Groups. A Plan can have up to 16 groups (0 to 15). Each group has a time and an influence allocated to it. When a Plan is introduced, each group in the Plan is in turn selected to run. As each group is selected, its particular influence/effect on the controller is applied for the duration of the time allocated to it. The total of all the group times is the cycle time for a Plan.

Thus, at a particular time of day, a pre-defined plan can be introduced to enforce a set of fixed duration effects on the controller.

Therefore, if a group of controllers each have 'Plans' designed for them, and they are all introduced at pre-determined times by the accurate Real time Master time clocks in each controller, it can be seen that the actions of the controllers can be co-ordinated, so as to create a fixed time form of control for a whole area.

When Plans are introduced, they normally start with the introduction of Group 0 and cycle around from that point.

However, there is an alternative method of Plan introduction and this has been designed to ease the drawing up/designing of Plans where different areas need to be brought into the CLF Scheme at different times of the day. Because, if Plan introduction always starts with group 0, the time at which the Plan is introduced will

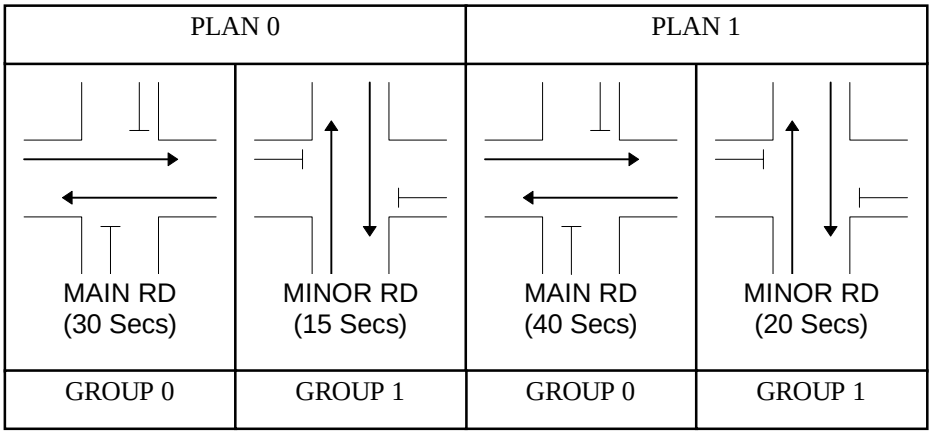
need to be carefully considered, if synchronisation with the rest of the system is to be achieved.

With the alternative method, when a plan is introduced, the controller works out which group would be running if the Plan had been running (starting with group 0) from a fixed time of the day, 2.00 a.m. The controller then starts at that group and continues from there. Within 3 cycles, the controller should be synchronised with influences of the Groups. Because every controller is introducing plans as if the Plans had all been running since the same base time 2.00 a.m., the actual time of Plan introduction is no longer critical.

(N.B. Certain contracts with this alternative method of Plan introduction require that from introduction of a plan the controller be synchronised with the group influences within 3 cycles of the Plan, and that during this Synchronising period, none of the stage durations should be more than 1.5 times, their normal duration under the Plan. This places certain constraints on the construction of the Plans, see section 9.9.8(e).)

For example, at a simple intersection (see Figure 9.5), a plan allocates 30 seconds vehicle flow to the main road (Group 0) and 15 seconds to the minor road (Group 1) for a cycle time of 45 seconds. Under this plan the controller cycles continuously between main road and minor road flows at 30/15 second timings under precise mains (or other source) synchronized control. Within the group timing allocated the red/amber/green sequence is a function of the main controller software.

Figure 9.5 - SIMPLE INTERSECTION WITH CLF



	GROUP 0	GROUP 1
PLAN 0	30 SECS	15 SECS
PLAN 1	40 SECS	20 SECS

9.9.1 Example Of Simple Linked Installation

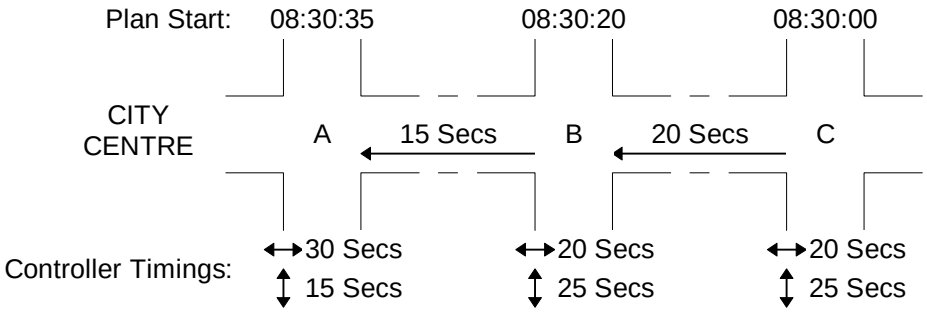
A simple linked installation covering three intersections on a main road into a city (Figure 9.6) is used as an example. At each of the three intersections A, B and C, a cableless linking facility is used to drive the respective controllers.

A 3-intersection stretch of main road, indicating group timings at each intersection and progressive plan starts/offsets along the route, for:

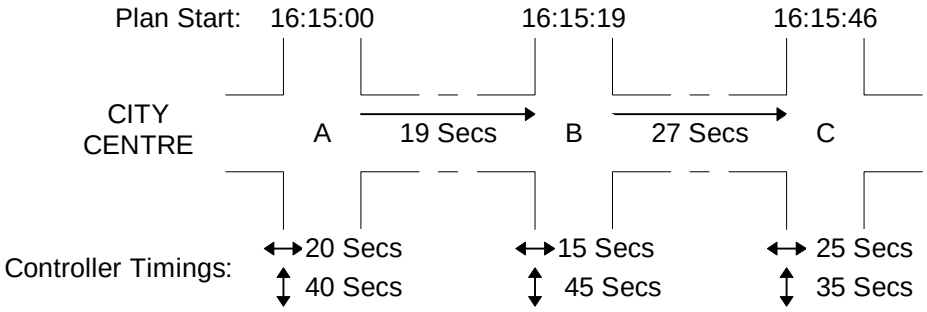
(a) Morning into-city peak (Plan 0)
(b) Evening out-of-city peak (Plan 1)

Figure 9.6 - SIMPLE LINKED INSTALLATION

(a) Morning Peak (Plan 0)



(b) Evening Peak (Plan 1)



9.9.2 Offset Timing

During morning peaks, traffic flowing into the city centre (C-B-A) is required to meet a succession of signals at green (a 'green wave'). Typically, free flowing morning peak traffic takes 20 seconds to travel from C to B and 15 seconds from B to A. The main road lights at B should therefore change to green 20 seconds after those at C, and those at A a further 15 seconds later. Offset timings of 20 seconds at B with respect to C, and 15 seconds at A with respect to B are therefore required.

The group timers in each linking unit are fully synchronous and, provided the total cycle time at each intersection is the same, the offset between controllers at the start of a particular plan is maintained until the next plan is selected.

The controller follows plans within the limits of minimum greens and intergreens by the respective time switches, whose settings incorporate the required offsets.

9.9.3 Different Plans And Offsets

Figure 9.6(a) illustrates the offsets and settings for the introduction of Plan 0 (morning peak) which is introduced at C at 08.30 and zero seconds, at B at 08.30 and 20 seconds, and at A at 08.30 and 35 seconds.

Similarly, during the evening peak - Figure 9.6(b) - the green wave of light is required for traffic moving out from the city centre (A-B-C). The evening plan, designated Plan 1, is introduced at A at 16.15 with B offset 19 seconds from A, and C 27 seconds from B.

9.9.4 Plan And Group Organisation

Operations in CLF mode are performed under control of up to 8 fixed time plans (0 to 7). Each plan consists of up to 16 consecutive groups (0 to 15), each group time being individually programmed for each plan with unused groups set to zero. If all group times within a plan are set to zero then the plan will not run.

The timing range of the group times is 0 to 255 seconds in 1 second steps.

The programmed values may be changed via the handset using the PLT command.

The influences exerted during the groups of a plan are programmed as an influence set. Usually the same influence set is used for each plan, but up to 8 different sets (0 to 7) can be programmed if required. Each influence set consists of 4 influences for each of the 16 groups (combination A, B, C, D).

The programmed influences may be changed via the handset using the commands; IFA, IFB, IFC, IFD and PLI.

A CLF plan is introduced by a timetable setting with a function number of ‘1’. The setting consists of the day type, hour, minute and second at which the change is to the effected and the plan number to be brought into operation. Figure 21.10 shows an example of timetable settings for plan changes.

The timetable settings that are programmed may be changed via the handset using the TSW command. If the timetable settings are not known at the time they may be added at a later date via the handset.

9.9.5 Group Influences

0. GO TO VA - allows vehicle actuation to operate except that phase maximums have no effect and phases may only terminate on a gap change. The controller is still in CLF mode. This influence should not be confused with the facility to isolate from CLF mode using a timetable setting when full VA facilities with maximum timings will be operative.

1. IMMEDIATE MOVE - requests an immediate move to a specified stage subject to minimum green and intergreen timings and stage to stage movement restrictions.

2. DEMAND DEPENDENT MOVE - requests an IMMEDIATE MOVE to a specified stage providing a demand exists for a phase within that stage.

3. HOLD - does not allow any stage change to occur. ROW will remain on the current stage at the time of the group change. Care should be taken if this influence follows a move that goes via an alternative stage, e.g. all-red, as the controller could then be held in all-red.

4. PREVENT - prevent all moves except to a specified stage providing a demand exists for a phase within that stage and providing no extensions exist for terminating phases.

5. ADD IMMEDIATE MOVE - adds an IMMEDIATE MOVE to the existing influence so that either influence may be actioned.

6. ADD DEMAND DEPENDENT MOVE - adds a DEMAND DEPENDENT MOVE to the existing influence so that either influence may be actioned.

7. IGNORE - continue with previous influence (for use on Parallel Stage Streaming)

8. INHIBIT - Inhibit Pelican Pedestrian on Pelican stream.

9. ALLOW - Allow Pelican Pedestrian on Pelican stream.

The Influence is followed by the number of the stage to which the Influence applies. The stream affected is the one containing the stage specified. The stream to which Influences 0, 3 and 7 apply is identified by specifying any stage within the stream.

With influences 2,4 and 6 if a demand does not occur then ROW will rest on the current stage until either a demand does occur or the group time elapses.

9.9.6 Examples Of Plans

See Figure 21.11.

9.9.6(a) Plan 0

The sequence will commence with an immediate move to Stage 1 during Group 0. If during Group 1 there is no demand for Stage 2 then Group 2 will force an immediate move to Stage 3 and Group 3 will hold it there. If there was a demand for Stage 2 during Group 1 (in this case just Phase C would be considered) then ROW would change to Stage 2 and the influence of Group 2 would be overridden by inter-green and minimum green timings. Group 3 would now hold Stage 2.

If at the start of Group 4 ROW was on Stage 3 then the influence would hold it there. If ROW was on Stage 2 then Group 4 would force an immediate move to Stage 3.

If during Group 5 there was no demand for Stage 4 and during Group 6 there was no demand for Stage 4 or 1 then ROW would remain on Stage 3 and Group 7 would hold it there. If there was a demand for Stage 1 during Group 6 then ROW would change to Stage 1 and Group 7 would hold it there. If during Group 5 or 6 there was a demand for Stage 4 then ROW would go there and Group 7 would hold it.

This set of influences could also be used with Plans 2 and 3 with different group times for different times of the day. (see Figure 21.10).

9.9.6(b) Plan 1

This plan would normally be used as an off-peak plan. The sequence will commence with an immediate move to Stage 1 during Group 0 followed by an isolate period during Group 1 in which ROW will change according to local demands and extension.

If the isolate period of Group 1 was followed directly by an immediate move to Stage 1 then it is possible that at the start of Group 0 a move had begun to a stage other than Stage 1. Group 0 would then be taken up by an intergreen and minimum green period which would override the influence of Group 0 and Stage 1 might never gain ROW during Group 0. The ‘prevent’ influence during Group 2 is used to prepare for the move to Stage 1 by holding the current stage and only allowing a move to Stage 1 if no current extensions exist and there is a demand for Stage 1.

9.9.7 Influence Set Combinations

Because the Influence Set Combinations (see section 9.9.4) all run at identical times, i.e. on each group output, it is possible to run more than one influence at the same time. This has a number of uses, e.g:

1) On Parallel Stage Streaming, each stream would normally be allocated a separate combination (see section 2.6.4) to allow different influences to work on different streams simultaneously and to simplify identification of each streams influences.

The example shown in Figure 9.7(a) would be for a two stream controller where Stream 0 contains Stage 1 and 2, and Stream 1 contains Stages 3, 4, 5. Influence Set Combination 'A' has been used for Stream 0 and Influence Set Combination 'B' for Stream 1. Stream 0 would move on groups 0 and 2; Stream 1 would move on groups 0, 1 if stage 4 is demanded, and group 2. It will be noted that Stream 0 will ignore group 1 and will continue to operate on influences set in group 0 (see section 2.6.4 on CLF).

2) On a single stream to give a choice of more than one demand dependant move simultaneously. For the example shown in Figure 9.7(b), at group output no. 3, either Stage 2 would be selected if a demand for Stage 2 was present or Stage 3 if a demand for Stage 3 was present with no demand for Stage 2.

3) On a single stream to give a choice of a demand dependant move or an immediate move simultaneously. For the example shown in Figure 9.7(c), at group output no. 2 either Stage 3 would be selected if a demand for Stage 3 was present or Stage 4 if a demand for Stage 3 was not present.

In this example the group timer for group no. 2 would normally be set to a short window time, e.g. 1 sec.

However, if the timer was set to a time greater than the intergreens to the demand dependant stage plus the minimum green of any phase running in that stage, then if a demand dependant move was made to stage 3 then it would be followed by the immediate move to stage 4.

In this way it is possible to build up complex stage change decisions within the CLF with a minimum of lost cycle time.

Figure 9.7 - EXAMPLES OF INFLUENCE SET COMBINATIONS

a)

INFLUENCE SET 1

	Influence Set Combination 'A'		Influence Set Combination 'B'	
	Group Inf	Related Stage	Group Inf	Related Stage
Group 0	1	1	1	3
Group 1	7	1	2	4
Group 2	1	2	1	5

b)

INFLUENCE SET 2

	Influence Set Combination 'A'		Influence Set Combination 'B'	
	Group Inf	Related Stage	Group Inf	Related Stage
Group 3	2	2	6	3

c)

INFLUENCE SET 1

	Influence Set Combination 'A'		Influence Set Combination 'B'	
	Group Inf	Related Stage	Group Inf	Related Stage
Group 2	2	3	5	4

9.9.8 Alternative CLF System

There is an alternative CLF system to the one previously described. This system operates such that at the time of a plan change requested by the master clock or the handset, the controller will calculate the group and group timer as if the group timer had been running since the base time (usually 2.00 a.m.) plus the required offset. This calculation on the plan change uses the values currently held for the plan and the time in the master time clock.

The base time is configurable as are the group times. Each plan has its own group offset time. The base time plus group offset is called the RESYNC TIME for that plan.

This alternative CLF system is a configurable option.

9.9.8(a)

In the Alternative CLF system each controller can have a group offset associated with each plan. This group offset is a configurable item and can be expressed in seconds only or in minutes and seconds. It can be changed via the handset, by using the "OFF" handset command.

9.9.8(b)

At 2.00 a.m. every morning, the controller will wait until the group offset time has expired, which may be 0 seconds, and then activate group 0 in the current plan. It will involve re-introducing the current plan. Group 0 will last for the length of time specified against group 0 for that plan. The group outputs will continue timing off and cycling onto the next group output within the plan.

9.9.8(c)

The time of day in conjunction with the time switch settings determines which plan is controlling the intersection under CLF mode. In the normal CLF system when the controller changes plan it starts the new plan at group 0, but in the Alternative CLF system when the controller changes plan it does a calculation to work out which group

it would be outputting and how many seconds have elapsed within this group if this plan had been in continuous operation since 2.00 a.m. Having done these calculations (i.e. current group has been determined and the number of seconds remaining in current group have been calculated) the plan change can occur.

9.9.8(d)

1) Due to 'CCP' Handset Command

Similar actions occur when the operator decides to restore cableless linking operation to real time clock via 'CCP' handset command.

In the normal CLF system, the time switch table is analysed to see what plan should be outputting. A calculation is done to see what group within this plan should be operating and how many seconds have elapsed within this group, has the plan been continuously operating since, the start time specified for this plan, in the time switch table. Having done these calculations, (i.e. current plan, current group and seconds remaining in current group) the plan change can occur.

The Alternative CLF system operates like the normal CLF system but in the Alternative CLF system, having calculated what the current plan should be, the current group is calculated as the group that should be outputting had this plan been in continuous operation since 2.00 a.m. that morning. (Thus 2.00 a.m. is used as the plan start time rather than the start time specified in the time switch table).

2) Due to Real Time Clock Sync (Refer to 9.3.3(k))

Actions as for (1) above.

3) Due to Real Time Clock Load (Refer to 9.3.3(j))

Actions as for (1) above.

4) Due to Handset Clock Load (CKL = 1)

Actions as for (1) above.

9.9.8(e) Method of Plan Introduction

Certain contracts require that, when using the alternative method of Plan Introduction mentioned above, the controller must synchronise with the Plan quickly.

To achieve this, the following constraints are placed on the CLF facility:

1. The Stage movement restraints table used by CLF should not have purely prohibited moves or ignore moves configured. They should either be allowed moves or if this is not acceptable for safety reasons, then alternative moves

should be specified. If alternatives are specified, it is preferable for the alternative stage to be one or two stages ahead in cyclic order of the original target stage. For example:

If the move 1-2 is not allowed
the alternative could be 1-3 or 1-4.

2. The use of the following group influences should be avoided if possible, but if not their use, i.e. the group time and Group position within the plan, must be considered carefully.

   i) Hold
   ii) Prevent

   The "GO VA" influence should not be used at all as this will nearly always cause disruption to the Synchronisation of Controller and Plan, even when used in CLF in general.

3. Group times should be a minimum of the maximum intergreen between the stage associated with the group influence and the stage associated with the previous group influence. Plus the longest minimum green of the phases appearing in the stage associated with the group.

   For example, if Group 0 is an immediate move to stage 1 and Group 1 is an immediate move to stage 2, then the minimum time for group 1 should be longest phase intergreen between Stage 1 and 2 and longest minimum green of phases appearing in Stage 2. Longer Group times will obviously aid synchronisation.

9.9.8(f) Grouptime Changes

A grouptime for any group within a plan which is not in operation can be altered by handset at anytime during the day and when the plan is subsequently introduced, it will immediately be synchronised with any other controllers which are running the cycle time of the new plan.

If the grouptime for a group within a plan is changed by the handset whilst the plan is actually running, i.e. current, then in the normal CLF system, this would mean that the controller would not be synchronised with another controller which was running the new cycle time, unless there was a plan change away from current plan and subsequently back to the same plan. This problem is solved in two ways.

1) Use 'CCP' Command (Handset)

   If the operator after changing a grouptime within the current plan, enters a 'CCP = 1' handset command this will cause the controller to introduce the current plan thus introducing the new grouptime(s).

2) Use Background Timer (Automatic)

If required (specified by handset command), then every time a grouptime within the current plan is changed the automatic plan re-entry delay timer is loaded. This timer is decremented every second. When the time has expired the controller automatically re-introduces the current plan. The time in the automatic plan re-entry timer is configurable and is changeable via the handset.

9.9.8(g) Alternative CLF Handset Commands

1) Automatic Plan Re-entry Delay Time Switch 'PRS'

If the data associated with this handset command is set to one then after a grouptime change occurs in the current plan, the current plan will be re-introduced when the automatic plan re-entry delay timer has expired (see PRD below).

If the data associated with this command is set to zero then no automatic plan re-entry will occur. Therefore the controller will not be synchronised with the other controllers with the same cycle time until a 'CCP' command is entered or unless there is a plan change away from the current plan and subsequently back again, or at the resync for this plan.

2) Automatic Plan Re-entry Delay Time 'PRD'

This handset command may be used to display or alter the automatic plan re-entry delay time.

`PRD x` (if x = 0, alter/display minutes
x = 1, alter/display seconds)

3) Group Offset Time 'OFF'

This handset command is used to display or alter the Group Offset Time.

`OFF x y:n` x - the Plan number
y - identifies whether n is the value in minutes or seconds.

i.e. y = 0, then n = number of seconds, if y = 1, then n = number of minutes.

e.g. OFF 5 1 = 25
This handset command will change Plan 5's Group offset minutes value to 25.

9.9.9 CLF Parallel Stage Streaming Facilities

The controller has up to 8 plans. Each plan can run up to 16 groups. Each group, when active can operate up to 4 influences simultaneously, 1 influence for each stream. There is an influence set for each plan, where an influence set consists of 4 influences for each of the 16 groups. (Combinations A, B, C and D). In general, Influence Set

Combination ‘A’ would be used for Stream 0, Influence Set Combination ‘B’ for Stream 1, etc.

In this way, it is possible on introduction of a group, to operate different influences at the same time on different streams.

If it is required that, during a given group timing, a stream is not required to change influence, then this stream’s influence should be set to Group Influence number 7, followed by the related stage number, i.e. the number of any stage contained within the stream upon which the influence acts. (See section 9.9.7, Figure 9.7(a).)

Only one plan can be in operation on the controller at once while in CLF. CLF can run on all streams at once or on some streams with the remainder running higher priority modes. If CLF is disabled on a stream then that stream will run the next lower priority mode.

For further description of CLF mode see section 9.8.

9.10 VEHICLE ACTUATED (VA) MODE

In VA mode the controller monitors all demands, extensions and maximum green timers every 200 mS to select a suggested stage in order to satisfy as many demands as possible without missing any stage containing a phase with a demand.

If the suggested stage is different from the current stage then the prohibited move table is monitored to see whether an alternative move should be selected or not. If the prohibited move is to be ignored, the above process is repeated ignoring demands for the original suggested stage.

If the move to the suggested stage is permitted, then the phase minimum green timers in the current stage are monitored to see when the change may take place, i.e. when the last minimum green for phases in that stage have timed off.

Figure 9.8 illustrates an intersection where if there are no phases extending, then the stage changes are straight forward. During Stage 1 a demand for Phase E will take ROW to Stage 2, a demand for Phases E and F will take ROW to Stage 3 and a demand for Phases E, F and G will take ROW to Stage 4.

However, if during Stage 1, Phase A is extending and Phase B is not, then a demand for Phases E and F would take ROW to Stage 2 to satisfy the extensions of Phase A and the demand for Phase E. The maximum green timer of Phase A will have been started by the demand for Phase F, so Stage 2 will run until Phase A ceases extending and then ROW will move to Stage 3 to satisfy the demand for Phase F.

If phase B had been extending during Stage 1, then a demand for Phases E and F would start the maximum green timer of Phase B and Stage 1 would run until the end of the maximum green of Phase B or until Phase B ceased to extend. ROW would now go straight to Stage 3 to satisfy the demands of Phases E and F.

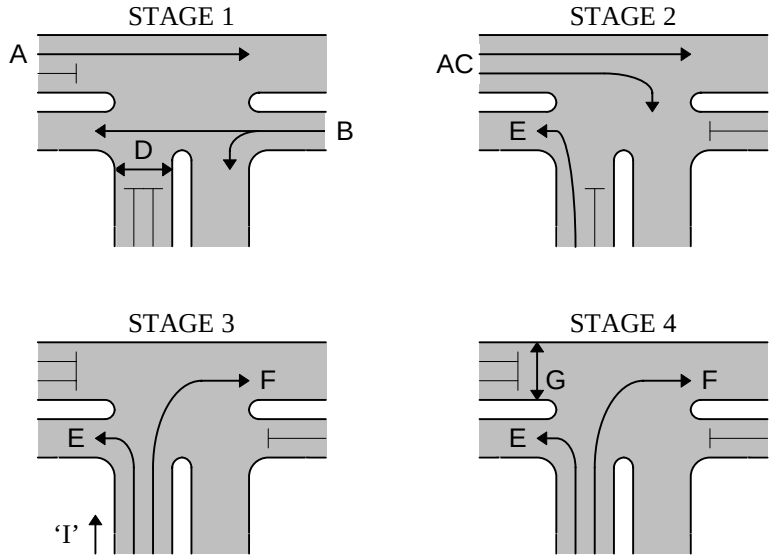
Similarly, if the demands for Phases E and F were inserted and neither Phase A nor Phase B were extending, then ROW would again go straight to Stage 3. The point at which a demand for Phase G was inserted would determine whether ROW would go to Stage 3 or 4. If the demand was inserted before the end of Stage 1 or 2 then ROW would go to Stage 4.

A stage change will not occur unless there is a demand present for either a phase within the new stage or the new stage itself, regardless of how the demand originated.

In Figure 9.8, if during Stage 4 it was required to move to Stage 3 after the minimum green of Phase G had expired a demand would have to be created either for Dummy Phase I or Stage 3. Dummy Phase I would also be required to provide a minimum period for Stage 3 as the minimum greens of Phases E and F would have timed off in Stage 4.

Without Dummy Phase I, Stage 3 would only be dependent on the extensions of Phases E and F and if these extensions ceased during the 4-3 interstage then Stage 3 would terminate as it became active.

Figure 9.8 - EXAMPLE OF VA STAGE CHANGES



9.10.1 Arterial Reversion

After a phase has gained ROW, if there are no other demands then ROW will remain on that phase. The arterial reversion facility allows ROW to revert to a specified stage or phase in the absence of any demands and extensions, subject to any minimum green periods timing off and any stage movement restrictions.

If a stage is specified, then the reversion will always be to that stage, but if a phase is specified, then reversion will be to the next stage in cyclic order in which that phase appears.

If ROW is on a phase that is extending with no other demands or extensions and that phase appears in the arterial stage or appears in another stage with the arterial phase, then a change to that stage will take place.

The name of the facility is derived from its normal use, which is for intersections with a main (or arterial) movement. During quiet periods, especially at night, ROW will revert to the main movement after a side road has had ROW, so that isolated vehicles on the main movement will not have to demand ROW and then wait for an intergreen period from the side road to time off. In this case, a stage would normally be specified for reversion.

Another use of the facility is on bridges with shuttle working. If the all-red movement is reverted to then isolated vehicles from either direction would only have to wait for a red/amber period before gaining ROW. If more than one all-red stage is used with the same dummy phase in each stage, then this phase would be specified for reversion allowing the next all-red stage in cyclic order to become active.

Figure 21.5 indicates where to specify the required stage or phase.

9.10.2 Arterial Reversion Parallel Stage Streaming Facilities

There is an Arterial Reversion facility for each stream. If there is no demand or extension present for any phase in the stream, and no demand for any stage in the stream, then an Arterial demand for a phase or stage in the stream will be inserted, if specified in configuration.

9.10.3 Parallel Stage Streaming Facility

Each stream will move around its own stages according to its own on street demands and extensions independent of any other streams.

9.11 FIXED TIME WORKING

There are two methods of obtaining fixed time working:
- Fixed Time mode
- Vehicle Actuated (VA) mode with permanent demands and extensions.

9.11.1 Fixed Time Mode

Fixed Time Mode is implemented:

- when FIXED TIME is selected on the mode select buttons subject to mode priority.
- by default, if there is no higher priority mode is active and no VA.

During Fixed Time mode, the controller cycles round a pre-programmed sequence of stages disregarding local demands and extensions. The stage durations are exclusive to the Fixed Time mode and do not include intergreen timings or phase delays which will be implemented as during Vehicle Actuated mode. The stage duration can be changed via the handset but the stage sequence cannot. Not all stages need be included in the sequence. No stage can appear more than once in a cycle. If, for example a movement is required to appear twice in the same cycle then two identical stages must be used.

Phases which appear conditionally will always appear in their corresponding stages, i.e. there will be permanent requests.

The range of the timing period for the stage duration is 0 to 255 seconds in 1 second steps. There is only one set of timings.

The programmed values may be changed via the handset using the FIX command.

Any all-red extension periods are automatically extended up to the maximum value to ensure safe operation.

When Selected Fixed Time mode ceases, demands may be automatically inserted for selected non-running phases to force a particular sequence. These demands are normally inserted to ensure no vehicles are trapped against a red light, unless otherwise requested by a customer.

9.11.2 Fixed Time to Current Maximums (VA Mode with Permanent Demands and Extensions)

This method of fixed time operation can only be implemented with the use of special conditioning.

When FIXED TIME is selected on the mode select buttons. The function of the button is changed, using Special Conditioning, to select Vehicle Actuated mode and to insert permanent demands and extensions for all phases, providing no higher priority mode is active. The controller will then operate to VA mode strategy and not to a pre-programmed sequence as in Fixed Time mode.

If Fixed time to current maximum is to be the default/lowest mode of operation. Then VA is configured once and special conditioning written such that when VA mode is operational, permanent extensions and demands are inserted.

(N.B. It is Normal to have Fixed time to current maximums only as an alternative to "Selected Fixed Time" and not as the default mode.)

This method of operation has been created so that the following are possible:

- Phases which appear conditionally may be excluded from having permanent demands and still rely on local demands for their appearance.

- Any set of maximum green timings may be introduced giving four sets of fixed times by the master time clock.

With Selected Fixed Time to current maximums, when NORMAL mode is restored there will still be demands present for all non-running phases, so no vehicles will be trapped against a red signal.

In the example in Figure 21.5, both methods of fixed time working are illustrated although only one may be implemented.

In the standard Fixed Time mode, it is required to cycle between Stages 1, 2 and 3 using stage durations 15, 10 and 18 respectively.

In the fixed time to current maximum mode, it is required to have phases C and D dependent on local demands. The controller will then cycle between Stages 1, 3 and 4 with stage durations defined by the current maximum green times. If Phase C or D is demanded, it will cycle Stages 1, 2, 3 and 4.

9.11.3 Fixed Time Parallel Stage Streaming Facilities

There are two options:

9.11.3(a) Independent Fixed Time

Each stream will have its own fixed sequence of stages and will move around it independently of the other streams.

9.11.3(b) Linked Fixed Time

Fixed time mode can be configured to provide Linking between stage combinations in different streams as an alternative to 'normal' fixed time mode which forces moves on each stream independently.

A maximum of 16 fixed time steps will be provided. Specified for each of these 16 times will be a configured stage combination. See the following example.

When linked fixed time is introduced, the Controller will move to combination 0, combination 0 time duration will start when all stages have appeared. When time 0 duration has expired the controller will move to combination 1 and combination 1

timer will start when all stages have appeared. This process will be repeated for each configured stage combination, until either the last available (i.e. sixteenth) or last configured stage combination is reached. In these cases stage combination 0 will commence again.

During Linked Fixed time mode the controller will display fixed time mode on the handset (Mode 1).

Fixed time mode need not be active on all streams. Only the streams that have fixed time active will be demanded through the specified stage combination.

EXAMPLE
Four Streams with the following Stages allocated to each:

STREAM	STAGES
0	0, 1, 2, 3
1	4, 5, 6
2	7, 8, 9
3	10, 11, 12

Where Stages 0, 4, 7 and 10 are All Red Stages.

If Streams 2 and 3 are to run independently in Fixed Time Mode, then Streams 0 and 1 could run the following linked sequence (for example):

STREAMS	COMBINATION	STAGES RUNNING TOGETHER
0 and 1	0	1 and 5
0 and 1	1	2 and 5
0 and 1	2	3 and 6

9.12 MODE PRIORITY

The mode priority facility allows for the mode with the highest priority for which operating conditions are active (e.g. force bits from the UTC computer or a hurry call demand) to be the current mode. When the operating conditions become inactive, then the next highest priority mode with operating conditions active will become the current mode. It need not necessarily be the next one in line. If at any time operating conditions for a higher priority mode become active, then that mode will become the current mode. If more than one set of operating conditions are active then the mode with the highest priority will become the current mode.

In order to achieve this facility, the mode select buttons on the manual panel are left in the NORMAL position.

The current mode may be read via the handset using the MOD command.

If VEHICLE ACTUATED mode is in the priority list then this must be put as the lowest priority. If VA mode is not required then FIXED TIME mode must be the lowest priority.

For priority purposes, SELECTED MANUAL CONTROL and SELECTED FIXED TIME, CLF OR VA are considered as modes. The operating conditions for these modes are the relevant mode select buttons being selected, i.e. MANUAL, FIXED TIME, CLF or VA.

Fixed time, CLF or VA selected via the manual panel are considered as different modes to 'normal' VA, CLF or Fixed time modes. This allows VA or Fixed time to be configured as the lowest mode, i.e. the one in which the controller will operate if no higher priority modes are requested. Whilst SELECTED VA or FIXED TIME mode can be configured higher up the mode priority table, so that if necessary, the controller can be forced to operate in VA or Fixed time, even if there are requests for modes of higher priority than the basic VA or Fixed time.

e.g.

Priority	Mode(s)
1	Selected VA, CLF or fixed time*
2	Hurry
3	Priority
4	UTC
5	CLF
6	VA

(* This will allow controller to be forced to operate in the Selected mode even if any of modes 2-4 are requested to be active).

To select Fixed Time, CLF or VA, the appropriate mode select button on the manual panel must be selected.

Similarly to select Manual mode the MANUAL mode select button is selected and if SELECTED MANUAL CONTROL is a higher priority than the current mode then manual mode will become operational.

If when Fixed Time, CLF, VA or Manual have been selected, they are not a higher priority than the current mode then no change of mode will occur.

EMERGENCY VEHICLE, HURRY CALL(S) and PRIORITY modes must always have a higher priority than VEHICLE ACTUATED mode (or FIXED TIME mode if there is no VEHICLE ACTUATED mode) but their priority above other modes is dependent on the required method of control of the intersection.

In the example of a mode priority table in Figure 21.8, UTC mode is the top priority. While there are force bits present from the UTC computer this will be the current mode. A hurry call request, the correct time of day for CLF or selection of Manual, Fixed Time or VA will have no effect. When the computer comes off line and drops the force bits then CLF will become the current mode, if it is the correct time of day. If it is not then Vehicle Actuated mode will become the current mode. If CLF is the current mode then a hurry call request will still have no effect but, selection of Manual, Fixed Time or VA will make the relevant mode operational. The hurry call request will only be honoured when Vehicle Actuated is the current mode.

Several different stage change conditions for different modes may be active at the same time, but the controller will only respond to the ones of the highest priority mode. When a change of mode occurs, the controller will respond to the current stage change conditions of the new mode. For example, during UTC mode a CLF plan will continue to run with the group influences having no effect. When the mode changes to CLF the current group influences will become effective.

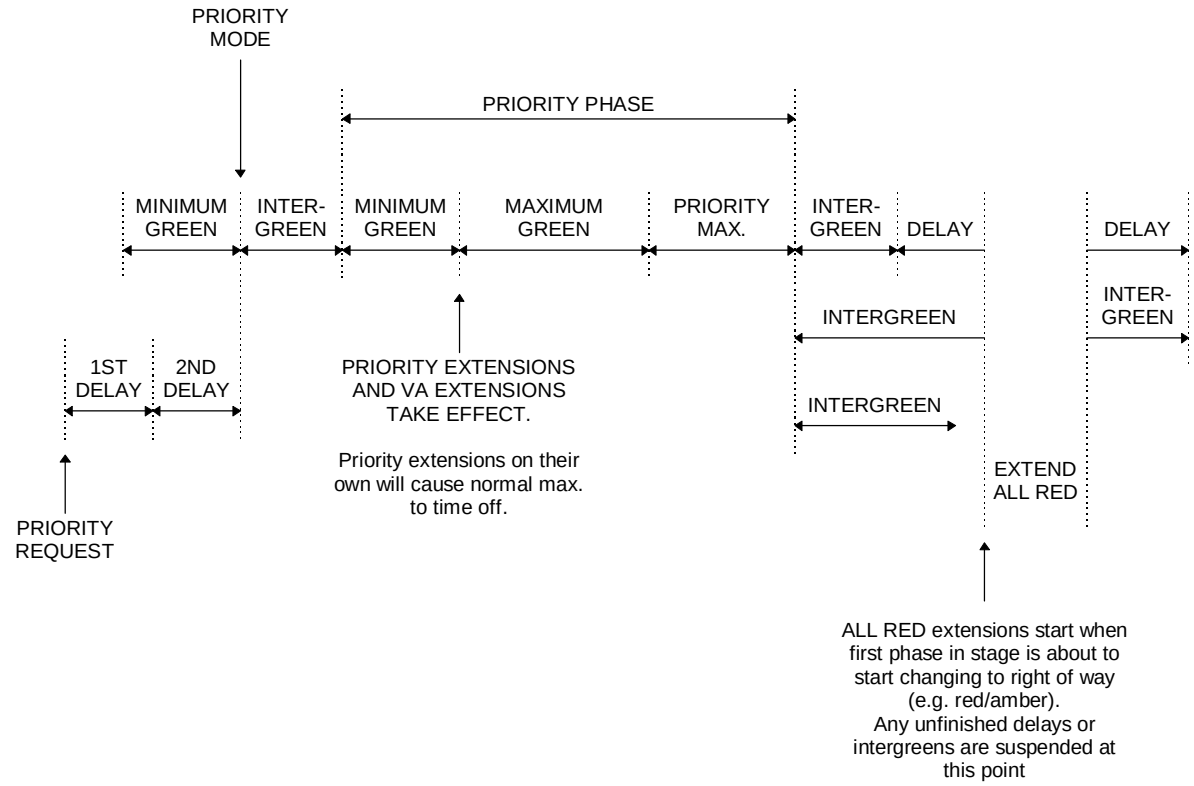
Changing of modes cannot override minimum green and intergreen timings.

Note: The controller must never be without a mode requested. Therefore, either VA or Fixed Time must always be configured in the mode priority.

9.13 TIMER RELATIONSHIPS

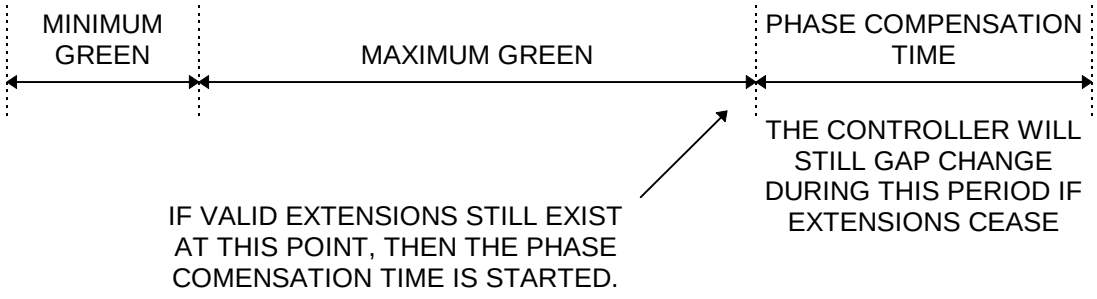
Below is a simple diagram intended to indicate the relationships between the various timers in the controller:

Figure 9.9 - GENERAL TIMERS



If a phase is terminated early (i.e. during its maximum green time, whilst there are still outstanding extensions), due to a Priority/Emergency demand. Then, if the phase terminated has been allocated a phase compensation time against the particular priority unit from which the priority demand originated, the phase compensation time may be implemented as below when the phase next has right of way.

Figure 9.10 - PHASE COMPENSATION


MINIMUM GREEN
MAXIMUM GREEN
PHASE COMPENSATION TIME
THE CONTROLLER WILL STILL GAP CHANGE DURING THIS PERIOD IF EXTENSIONS CEASE
IF VALID EXTENSIONS STILL EXIST AT THIS POINT, THEN THE PHASE COMENSATION TIME IS STARTED.

10. STAGE MOVEMENT RESTRICTIONS

When a specific stage change is required not to occur for safety or traffic control reasons, it is possible to restrict the move.

The type of restrictions available are:

(a) PROHIBITED MOVE:

This is the most restrictive and the effect is for the controller to stay on the same stage and not look for other moves until the stage change conditions are altered.

(b) ALTERNATIVE MOVE:

With this, the restricted move is not made but an alternative stage is specified and a move to that stage takes place.

(c) IGNORED MOVE:

This is less restrictive than a Prohibited Move in that the restricted move is ignored, but the controller looks for another satisfactory stage change.

The above movement restrictions can apply in one or more modes, as specified on the configuration sheets. Four sets of alternative and/or ignore move tables are available, and 8 sets of Prohibited move tables.

Within the controller itself, there are two sets of movement tables, one set with the Prohibited/Allowed moves and another set which define those prohibited moves which are to be Ignore moves and which have alternatives. When configuring a controller, the configuring engineer must translate the data on the customer spec sheets as follows:

For every Prohibited, Ignore or Alternative move the move should be made prohibited in the “Prohibited/Allowed moves table”. Then in the appropriate “Alternative moves table” the Ignore and Alternative moves should be defined.

If, in deciding a stage change, the controller encounters a prohibited move, it then looks in the appropriate Ignore/Alternative move table to see if another movement is possible.

WARNING

To avoid the possibility of locking-up the controller, PROHIBITED MOVES should not be applied during modes other than Manual, UTC or CLF - IGNORE or ALTERNATIVE MOVES should be used instead.

If SMOOTH PLAN CHANGES are required in UTC and CLF Modes, (e.g. Hong Kong Controllers), Prohibited and Ignore moves should not be used. See Sections 9.3 and 9.9.

10.1 PROHIBITED MOVES

When a move to a stage is prohibited and there is a demand for the prohibited stage, the controller will not move to that stage and the current stage will remain active until either of the following happens:

(i) the stage change conditions alter and a move can be made to a stage before the prohibited stage.

(ii) the stage change condition is removed and replaced by another stage change condition.

(iii) the stage change restriction is removed due to a mode change.

In (i), after the stage change occurs, a move to the original prohibited stage might now be permitted.

In (ii), the only modes that could achieve this are:

Manual - by the operator seeing the prohibited move light illuminated and selecting another stage by means of the appropriate push-button.

UTC - by the force being removed and another one applied.

CLF - by another group influence becoming active.

In the example in Figure 21.6(a), the move 2-1 is prohibited in Manual mode, because the indicative green arrow Phase C must terminate with Phase B (see section 3.2.3(b)), and the move 4-3 is prohibited because of the required method of control.

10.2 ALTERNATIVE MOVES

When a move is not allowed it may be possible to specify an alternative move to a nominated stage. The stage may either be one that is in general use or one that is used only for the alternative move.

If the nominated stage is in general use, any move out of it will be subject to any current stage change conditions and may not go directly to the original required stage.

If the nominated stage is used only for the alternative move then the only permitted move to it will be from the original current stage and the only move out of it will be to the original required stage. All other moves out of it will be restricted by specifying an alternative move to the original required stage. This will ensure that the original required stage is reached before any other stage change conditions are satisfied.

In the example in Figure 21.6(a), the move 4-3 is not allowed, but an alternative move into stage 1 is required in VA, UTC and CLF modes. When Stage 1 gains ROW there

may be stage change conditions present for Stage 2 and ROW will go there before Stage 3.

In the example in Figure 21.6(a), the move 2-1 is not allowed, but an alternative move into stage 0 is required in VA, UTC and CLF modes.

In these modes, Stage 0 is only used for this alternative move and so all moves out of it, apart from Stage 1, are prohibited with an alternative move to Stage 1. During Manual mode the move 0-1 is allowed.

10.3 IGNORE MOVES

When a move is restricted and a nominated alternative stage is too restrictive, it is possible to programme the controller to ignore the restricted move and to look for another satisfactory stage to change to. The stage change conditions for the original restricted move will still be present and after another stage change has occurred they will be considered for any further stage changes.

The ignore move facility is normally only required during modes where it is possible to have stage change conditions present for more than one stage, i.e. VA, Priority, Emergency Vehicle and UTC mode.

In the example in Figure 21.6(a) the move 4-5 is an ignore move during VA, UTC and CLF mode. Stage 5 is a hurry call stage and is only used during that mode. In UTC mode there is no force condition for Stage 5 so it will never appear but during VA and CLF modes, a demand for Phase E during Stage 4 will try and initiate a change to Stage 5. If the move was just prohibited, no further stage changes would take place and so the move is programmed to be ignored.

10.4 PERMITTED MOVES

Permitted moves are not programmed they are achieved by the lack of any stage movement restrictions.

Although a stage may only appear in one mode, there will be occasions when the stage is active and the mode changes. Moves are therefore permitted out of it during the other modes to allow for the stage change conditions of the new mode.

In the example in Figure 21.6(a) Stage 5 is used only during Hurry Call mode, but once the hurry call has been serviced, Stage 5 will be active in whichever mode takes over. Moves to Stage 5 are restricted (Ignored) in all other modes but moves out of it are permitted.

10.5 PREVENTED STAGES/PHASES

The deletion of a stage or phase, which may be achieved by use of the master time clock, see section 11, may be simulated by preventing them when certain conditions occur using Special Conditioning Software.

If a stage is prevented it will be omitted from the cycle.

If a real phase is prevented, then the signals will remain at red whenever a stage that the phase normally appears in is active. If the prevented phase is the only phase allocated to a stage, then the stage will not appear in the cycle.

If a dummy phase is prevented, then any effect its appearance has on stage changes or timings will be cancelled.

The prevention of stages or phases is effective in all modes except Fixed Time mode.

In the intersection in section 21, Figure 21.20 illustrates a special stage change condition during VA mode for the move 1-4, i.e. a demand for Phase F and no demand for Phase E. Normal VA stage change conditions would cause a stage change 1-3.

To achieve the move 1-4, Stage 3 would be prevented while the required conditions occur, i.e. in Stage 1 with a demand for Phase F and no demand for Phase E.

If any of the conditions are cancelled before the move takes place, e.g. a demand for Phase E is inserted or a change to Stage 2 occurs, then the prevent on Stage 3 would be removed.

11. THE MASTER TIME CLOCK SYSTEM

11.1 INTRODUCTION

The master time clock system (MTCS) provides the following facilities:

- A software clock.
- A crystal oscillator and standby RTC circuit which is battery supported.
- A software timetable (see section 12).
- Plan timings for cableless linking in software (see section 9.9).
- Plan influence definitions in software (see section 9.9).

The software real time digital clock which controls the system has a resolution of one second and records seconds, minutes, hours, days and weeks. The clock is normally triggered by 50Hz signals derived from the a.c. mains supply, i.e. a convenient source available to all controllers in a linked system permitting synchronism to be maintained without inter-connection.

In areas where the stability of the mains frequency is unsatisfactory, a high precision crystal oscillator signal can be used in place of the mains derived signal. This may be introduced via the handset using the CTS command.

The handset command MST may be used to specify a time when a changeover from crystal to mains is to occur.

11.2 REAL TIME CLOCK (RTC)

The RTC maintains the current time of day in hours, minutes, seconds and week numbers.

The clock is set up via the handset using the WEK, STM & CKL commands.

The current time of day may be read via the handset using the TOD command.

The clock is normally driven from the mains frequency. Short mains breaks (50mS or less) which do not cause the controller to shut down are compensated for in the clock software module. If a longer break occurs, the standby system on the RTC circuit counts the period for which the power is off. These circuits derive their power from a lithium battery which is switched and mounted on the Main Processor PCB.

On restoration of the power, the duration of the power failure is read from the RTC circuit. This period is then added to the time value saved when the power went off, to establish the new time.

The battery maintains the circuit operation and powers the RAM so that the time of day is not lost even if the PCB is removed from the PCB module.

If the mains fails for more than 30 days (this threshold is configurable and also alterable via handset PFD command) then an entry is made in the fault log and the RTC time is considered invalid. The timetable is then not available and the timetable settings are set to their default state.

11.3 TIMETABLE RESOLUTION

CLF plans and timetable events are introduced by timetable settings to a resolution of 1 second.

11.4 BRITISH SUMMER TIME CHANGES

The RTC will advance or retard one hour at 02.00 hours on the Sunday morning of specified weeks to allow for the time changes of British Summer Time.

When the clock is advanced, any CLF plan change or timetable event facility that would have occurred between 2 a.m. and 3 a.m. will automatically be brought into effect.

When the clock is retarded, a return to the conditions applicable at 2 a.m. is automatically implemented.

The programmed week numbers may be changed via the handset using the BSA and BSR commands.

Note: The advance and retard week numbers are not reset after being actioned and will be effective the following year unless changed or set to ‘0’ to inhibit the facility.

11.5 MINUTE PULSE

This signal is of 5 seconds duration and begins 5 seconds before each 5 minute boundary of the RTC. It is available to special conditioning and therefore may be allocated to a normal T400 output Port bit. Conditioning bit goes active for duration of pulse.

12. THE EVENT TIMETABLE

12.1 PLAN CHANGE/EVENT TIMETABLE

There are 64 entries in the Event Timetable. Within each entry, the following 6 pieces of information are specified.

1. The Day Type, which is a number that indicates the day(s) on which this Event occurs.

Number	Significance
0	Saturday
1	Sunday
2	Monday
3	Tuesday
4	Wednesday
5	Thursday
6	Friday
7	Every Day
8	Every Day except Sunday
9	Every Day except Saturday and Sunday

2. The Hours value at which the event is introduced.

3. The Minutes value at which the event is introduced.

4. The Seconds value at which the event is introduced.

5. The Time Switch Setting Command Code which indicates what function is to be performed when this Time Switch Setting is reached. Possible Codes are one of the following:

   a) Isolate, i.e. Switch the controller to VA operation.

   b) Selects the Plan number. The actual Plan number to be selected is specified.

   c) Change the Switch Function Settings to those as specified.

6. The extra information required for option b) and c) in 5 above.

12.2 CABLELESS LINK PLANS

The cableless link plans define the timing period for each group but the actual function of the group is determined firstly by the group influence set which applies and secondly by the group influence definition contained within the particular set.

Refer to Section 9.9 for CLF Mode operation.

12.2.1 Synchronisation of Cableless Linking Equipment

Synchronisation of Cableless Linking Equipment (i.e. maintaining required offsets for the running plan) in adjacent controllers can be achieved either by the UTC computer or by operators locally adjusting the real time when no link to the UTC computer is existing, or is not required.

The UTC computer can correct small errors in the real time clock by sending a command at one of the following minute boundaries past an hour 8, 18, 28, 38, 48, 58. This would correct the Real Time Clock if the error was no more than 29 secs (see section 9.3.3(9.3.3(k))).

The UTC computer can set the real time in the controller to a pre-programmed system time and the computer will send the control signal at the time which is programmed (see section 9.3.3(9.3.3(j))).

In the absence of the computer system, adjacent controllers can easily and accurately be synchronised by local operators setting the controller RTC to 'system time' using one controller as the master reference. No other adjustments are necessary to synchronise the controller to adjacent controllers running the current local co-ordinated mode system plan. Thus, if an UTC computer is not used, a limited "urban traffic control" strategy may be implemented using CLF plans to link controllers in an area.

(See Appendix C of the "T400 Controller Handset Command List" for details of synchronisation procedure.)

12.3 SWITCH FUNCTION SETTING

The event timetable is introduced by a Master timeclock timetable setting with a function number of '2' (see Figure 21.12). Following the function number 2 in the MTC timetable will be a 'Parameter' number. This parameter number refers to a combination of event switches which are required to be inoperative '0' or operative '1'.

Thus, when the MTC invokes a timeswitch parameter, a combination of events may be set operative or inoperative (see Figure 21.13).

In the event of a timeclock failure, all the timetable settings are set to their default state (see section 12.3.1).

16 event switches are available to be defined (0-15), each one may be defined as any one of the following event types:

(a) Switch an Input/Output Active/Inactive/Normal

An input or output will operate as normal until switched active or inactive by a timetable setting. Switching it active will set it permanently active, while switching it

inactive will set it permanently inactive. The state will continue until another timetable setting switches it back to normal.

In the case of a detector input, the permanent active or inactive state will neither cause the Detector Fault Monitor to start timing nor affect the monitoring of the detector.

In the example in Figure 21.13, Detector C1 is set inactive during Parameters 1 and 2.

(b) Introduce Alternative Maximum & Priority Time Settings

The standard maximum green times (Set A) for phases and standard Priority times (Plan 0), if Priority mode is required, will be effective until switched by a timetable setting.

There are three alternative maximum sets (B to D) and another three Bus Priority plans (Sets B to D or Plan 1 to 3) available. Switching an alternative maximum facility active will automatically switch the corresponding Bus Priority plan active.

All phase maximum green timings and all Bus Priority unit timings are switched when an alternative maximum facility is introduced. Therefore, any timings that are required not to be changed in an alternative plan, should be set to the same value as in the previous plan.

Any timer that is active at the time of switching will remain effective until the next start of that timing period.

e.g. If a maximum green of 50 seconds is timing off and the maximum is switched in the middle of that 50 seconds to a new value of 30 seconds, the 50 seconds will still be timed. The 30 seconds will become effective when that maximum green timer next has a reason to start.

(c) Switch a Sign On/Off

A secret sign whose default state is extinguished may be illuminated by a timetable setting. Alternatively a secret sign whose default state is illuminated may be extinguished by a timetable setting. The facility used will depend on the required state of the secret sign in the event of a timeclock failure, i.e. extinguished or illuminated. If "Switch Sign OFF" is used, the default state will automatically be sign ON, but if "Switch Sign ON" is used, the normal state will automatically be sign OFF.
NOTE: The two different facilities should not be used with the same switched sign.

(d) Switch a Stage/Phase In/Out of Cycle

Any stage, apart from Stage 1, and any phase may be deleted and re-introduced by a timetable setting.

If a stage is deleted, then it will be omitted from the cycle until it is re-introduced.

If a real phase is deleted, then the signals will remain at red (or blackout in the case of a green arrow phase) whenever a stage that the phase normally appears in is active.

If a dummy phase is deleted, then any effect its appearance has on stage changes or timings will be cancelled.

When a stage is deleted, any demands for that stage or for phases within the stage must also be deleted by the same timetable setting, unless the phases appear in other stages.

In order to delete current demands and prevent further demands, it is recommended that such demands be deleted by using special conditioning to write a “FALSE” state to the entry in the latched or unlatched demand arrays for the appropriate phase/stage.

When a phase is deleted, any demands for that phase must also be dependent on the same timetable setting.

If the above two conditions are not met, then outstanding demands for stages or phases may never be satisfied.

The deletion of stages or phases is effective in all modes except Hurry Call and Fixed Time mode, as deletion of phase/stages associated with these later two modes would cause the controller to lock up.

If you wish to delete a phase or a stage and a form of fixed time working is required, then “Fixed time to Current Maximums” can be used. This uses the VA mode with permanent demands and extension. Thus if a phase/stage is to be deleted then provided demands for it are also deleted, it can be deleted without problems.

(e) Switch To/From Part-Time Mode

Part-time mode may be switched to and from by a timetable setting. See section 9.2 for a more detailed explanation.

(f) Switch A Conditioning Flag Active/Inactive

A conditioning flag that is required to indicate a particular time of day may be switched active or inactive by a timetable setting.

(g) Switched DFM

DFM can be switched between four different Timesets as required. The Monitor times can be adjusted by the Handset.

12.3.1 Event Switch Default States

Event	Default State
MaxSwitch	Set A and Priority Plan 0 selected.
CondSwitch	Conditioning flag false
I/P active	Input normal operation (following external influence)
I/P inactive	Input normal operation (following external influence)
O/P active	Output normal operation (following controller influence)
O/P inactive	Output normal operation (following controller influence)
Delete Stage	Stage not deleted
Part Time	Not Part time (i.e. signals illuminated normally)
Sign OFF	Sign will be ON
Sign ON	Sign will be OFF
Delete Phase	Phase not deleted
Change Timeset	Timeset A

12.4 PARAMETERS

All the required combinations of the event timetable facilities are programmed in a parameter array. 16 parameters can be defined, each containing any of the 16 switches (allocated to facilities, see Section 12.3). The switches are set to active for a parameter by insertion of a '1'. This allows a timetable setting not only to switch facilities in and out but also to maintain facilities at their current state (see Figure 21.13). The parameter is then allocated to a timetable setting which consists of day type, hour, minute and second (see Figure 21.12).

Any combinations not required initially, may be included in the parameter array for use at a later date. The request for a parameter may be added to a timetable setting via the handset using the TSW command. The parameter array cannot be changed by using the handset.

The individual facilities may be introduced via the handset by using the SWS command.

For example, refer to the intersection in section 21 and Figure 21.12 and Figure 21.13:

At 07:30 Alternative maximum Set B is introduced, Detector C1 is switched inactive, Dummy Phase I is deleted and the secret sign (NRT) is illuminated - Parameter 1. The last two facilities have the effect of Stage 2 not appearing and preventing right turning traffic on Phase B.

At 09-00 Alternative Maximum Set B is replaced by Alternative Maximum Set C but Detector C1 remains inactive, Dummy Phase I remains deleted and the secret sign remains illuminated - Parameter 2.

At 10-00 The standard maximum Set A is restored, Detector C1 is allowed to operate normally, Dummy Phase I remains deleted and the secret sign is extinguished - Parameter 0.

At 12-30 Alternative Maximum Set D is introduced and Dummy Phase I remains deleted with no other facilities - Parameter 3.

At 14-00 The standard Maximum Set A is restored and Dummy Phase I remains deleted - Parameter 0.

At 17-30 The standard maximum Set A is retained and Dummy Phase I is introduced to provide longer intergreen periods from Phases E and F to Phases A, B and G - Parameter 4.

At 19-00 Dummy Phase I is deleted and the standard maximum Set A is retained - Parameter 0.

If Alternative Maximum Set B and Set C are required to be introduced with no other facilities, then Parameters 5 and 6 are configured and they may be added later by handset.

Note: The illuminating and extinguishing of a secret sign would normally be dependent on the leaving amber of the associated phase as well as the timetable setting.

If this is required, Special Conditioning must be written to tie the secret sign to the amber leaving of the appropriate phase as well as the timetable setting. “SIGN ON” and “SIGN OFF” in timetable should not be used. Instead a conditioning flag is used in time table.

13. LINKING

13.1 PELICAN CONTROLLER

A link to an adjacent Pelican Controller may be provided for the purpose of inhibiting the appearance of its pedestrian stage until certain conditions occur within the Type 400 Controller, in order to prevent the intersection becoming congested.

The inhibit facility is incorporated within the Pelican Controller and the Type 400 Controller provides a signal for connection to it.

The normal method of operation is that the start or end of a nominated phase or stage in the Type 400 Controller starts a DELAY timer, the expiry of which starts a LIFT INHIBIT timer. The value of the DELAY timer is dependent on the layout of the intersection but the LIFT INHIBIT timer normally has a small value (e.g. 1 or 2 seconds) and acts as a window period for demands for the pedestrian stage of the Pelican Controller.

If a demand exists or matures during the window period, then the pedestrian stage is allowed to gain ROW subject to the method of control of the Pelican Controller. The inhibit is re-applied at the termination of the window period, but this will not affect the pedestrian stage if it has gained ROW.

If the Type 400 Controller is liable to rest on a phase or stage for long periods then an OVERRIDE timer may be provided in order to lift the inhibit in the event of the nominated phase or stage not starting or ending.

If the lifting of the inhibit is associated with the start of the nominated phase or stage then the OVERRIDE timer will commence timing at the end of the phase or stage and will be reset at the start.

If the lifting of the inhibit is associated with the end of the nominated phase or stage then the OVERRIDE timer will commence timing at the start of the phase or stage and will be reset at the end.

The expiry of the OVERRIDE timer starts the LIFT INHIBIT timer and the process is the same as before. The OVERRIDE timer will continue to run until reset.

The link may only be effective during certain times of the day if required.

A control bit (LL) may be transmitted from the UTC computer in order to remove the link if required.

If the Type 400 Controller fails or is switched off then the inhibit will be lifted.

Figure 21.19 illustrates a request for a link with an adjacent Pelican Controller. Figure 21.12 and Figure 21.13 illustrate applying and removing the link at certain times of the day (see section 12.2).

13.2 REPEAT PULSES

The Type 400 Controller may be linked to other traffic controllers so that a pulse which occurs, or a pulse which is created by a condition occurring, in one controller may be repeated to the other. The function of the pulse when received will depend on the method of control of the intersection.

One function of the facility is to maintain traffic flow through closely associated intersections. When a certain phase gains ROW, a pulse is transmitted to the linked controller to demand a phase along the same route.

Special conditioning is used to provide an output from the controller under pre-defined conditions, e.g. during Red/amber or amber leaving of a particular phase.

13.3 OTU LINKING

The Type 400 Controller may be linked to other controllers in a UTC scheme when it is required to share an outstation transmission unit (OTU) between more than one controller. In this case the link will only be for connection between the OTU and the other controllers. The operation of the controller will have no effect on the link.

14. ALTERNATIVE SIGNAL SEQUENCES AND FLASHING SIGNALS

14.1 ALTERNATIVE SIGNAL SEQUENCES

To change signal sequences requires changes in the controllers database values not accessible to users, such changes are performed by the Traffic Engineering Department of Siemens. Requirements of signal sequences must be clearly stated in tender documents, and any subsequent customer orders.

As the Siemens Controller configuring system (Configurator) is developed, fixed sequence options may be built in and these will be defined in the Configurator handbook and 'Customer Specification Forms'.

Traffic Phases

Some examples of alternative signal sequences are:

at no ROW:	RED	RED
changing to ROW:	RED	RED
at ROW:	GREEN	GREEN
changing to no ROW:	AMBER	GREEN/AMBER

In both examples, the omission of RED/AMBER for "changing to ROW" does not affect the length of the intergreen.

In the second example, the GREEN/AMBER would normally be the same value as AMBER LEAVING, i.e. 3 seconds.

The RED/AMBER and AMBER LEAVING periods in the standard signal sequence is fixed at 2 seconds and 3 seconds respectively in order to conform with Department Transport Specifications. These values may be changed in order to meet other specifications if required. For example, it is possible to specify a variable amber leaving time in a similar way to specifying pedestrian blackout times (see the LAT handset command).

Pedestrian Phases

The standard signal sequence for pedestrian phases does not allow for "changing to right-of-way" and "changing to no right-of-way". The power supply that drives amber signals on traffic phases is utilised to drive the wait indicator on a pedestrian phase.

An example of an alternative signal sequence is:

at no ROW:	RED MAN
at ROW:	GREEN MAN
changing to no ROW:	AMBER MAN

If this sequence is required, the pedestrian phase has to be programmed as a traffic phase in order to obtain the amber signal. If a wait indicator is required, this has to be programmed as a switched sign phase (see section 3.2.5(b)).

Green must always be used for “at right-of-way” for traffic, pedestrian & green arrow phases because of the green conflict facility.

14.2 ALTERNATIVE START-UP SEQUENCES

As an alternative to the standard start-up sequence and blackout during Part-time mode, the following may easily be provided as stated in above statement.

(a) Start-up Sequence

FLASHING AMBER for 6 seconds
ALL-RED for the length of the starting intergreen plus the amber leaving time.

With ROW going first to Stage 1 before completing one cycle.

(b) Part-Time Mode

At the changeover to Part-time mode, following the expiry of all phase minimum greens, ROW goes to an all-red stage (normally Stage 0) for a specified time. This is then followed by flashing amber to all traffic phases and blackout to all pedestrian and green arrow phases.

The specified time in the all-red stage is provided by allocating a dummy phase to the stage. The minimum green value of the dummy phase will provide the time.

At the changeover from Part-time mode the start-up sequence is effective.

(c) Other Modes

The signal sequence during all other modes remains the same as the standard sequence unless requested to be changed.

14.3 FLASHING SIGNALS

The signals on traffic, pedestrian and green arrow phases are normally a continuous display. If required, the display may be programmed to flash instead. Either the type of phases, i.e. traffic, pedestrian or green arrow, or individual phases may have a flashing display on one or more signals.

e.g. traffic phases:

at no ROW:	RED
changing to ROW:	RED/AMBER
at ROW:	GREEN
changing to no ROW:	FLASHING AMBER

pedestrian phases:

at no ROW:	RED
at ROW:	FLASHING GREEN

traffic phases:	Phases A,B & C	Phase D
at no ROW:	RED	RED
changing to ROW:	RED/AMBER	RED/AMBER
at ROW:	GREEN	FLASHING GREEN
changing to no ROW:	AMBER	AMBER

The displays that are programmed to flash will do so every time they appear. They cannot be programmed to be solid and flashing.

The flashing facility may also be applied to the start-up sequence and Part-time mode if required:

e.g.

Phases A,B & C	Phase D
FLASHING AMBER	FLASHING RED
RED	RED

Followed by ROW going to Stage 1 before commencing a complete cycle.

14.3.1 Variable Flashing Signals

The facility is available to have flashing traffic, pedestrian and LRT signals. The rate of flashing is adjustable with adjustable on/off ratio. The adjustment will be in 20mS steps for both on and off periods, with a limit of 5.1 seconds.

Due to the operation of the green monitoring system, a period of less than 240mS for the on or off time should not be used.

14.4 EXPORT SIGNAL SEQUENCES

The following is a list of some of the foreign signal sequences available. If other sequences are required, consult with the Siemens Traffic Engineering Department.

BAHRAIN: Blackout start-up and flashing amber part-time with standard British traffic and pedestrian sequences (no blackout).
Supply: 240V 50Hz.

CHINA:

Beijing: Normal startup sequence and blackout part-time mode.
Traffic: red - green - amber - red.
Supply: 220V 50Hz.

Shekou: Normal startup sequence and blackout part-time mode.
Traffic: as Beijing.
Ped: red man - green man - flashing green man - red man.
Supply: 220V 50Hz.

Shen Zhen Province: As Columbia, but 220V 50Hz.

COLUMBIA: Flashing amber start-up and part-time.
Traffic: red - green - amber - red.
Ped: red man - green man - flashing green man - red man.
Supply: 110V 60Hz.

DALLAH: Flashing amber start-up and part-time.
Traffic: red - green - amber - red.
Ped: red man - green man - blackout - red man
(usually as parallel peds).
Supply: 220V 60Hz
(except Dammam Port - 277V 60Hz. A special transformer is needed here).
Side road flash in part time may be red instead of amber. Amber leaving may also be requested as five seconds instead of the normal three.

EIRE: Normal start-up.
Traffic: red - green - amber - red.
Ped: standard (sometimes with blackout).
Supply: 240V 50Hz.

HONG KONG: Startup sequence:
A 7-10 second blackout, followed by all red usually 8 seconds. Then phases in starting stage go immediately to green.

The LRT phase sequence is:
Stop - Proceed - Flashing Proceed - Stop.

Proceed may be ahead, and/or left turn and/or right turn proceed signals. If two different ahead moves are required, a separate phase is required for each.

The vehicle phase sequence will be:
red - red/amber - green - amber - red.

The pedestrian phase sequence will be:
red man - green man - flashing green man - red man

Supply: 200V 50Hz

SYRIA: Flashing amber start-up and part-time.
Traffic: red - green - amber - red.
Ped: standard (with three second blackout).
Supply: 240V 50Hz (Damascus).

SRI LANKA: As Bahrain, but with flashing amber start-up. 240V 50Hz.

TRINIDAD: Flashing amber start-up with flashing amber (main road) and flashing red (side road) part-time.
Traffic: red - green - amber - red.
Ped: standard sequence.
Both 240V 50Hz and 110V 60Hz are used in Trinidad and Tobago depending on the actual location.

ZAMBIA: As Syria with 240V 50Hz.

15. INPUTS AND OUTPUTS

15.1 INPUTS (I/P)

Inputs into the controller may include the following:

(i) Demands and extensions from detectors (VA and Priority).
(ii) Demands from pedestrian push-buttons.
(iii) Extensions from SDE/SA assessors.
(iv) Extensions from all-red detectors.
(v) UTC control bits.
(vi) Links from other controllers.
(vii) Hurry Call requests.

15.2 OUTPUTS (O/P)

Outputs from the controller may include the following:

(i) UTC reply bits
(ii) Links to other controllers
(iii) Monitoring Signals
(iv) Hurry Call Confirmations
(v) Special Outputs to indicate certain states within the controller (e.g. controller fault output)

15.3 LOGIC CONDITIONS

The logic conditions of the inputs and outputs are shown in below:

	NON-UTC		UTC	
	ACTIVE	INACTIVE	ACTIVE	INACTIVE
INPUT	1	0	1	0
OUTPUT	1	0	0	1

The logic conditions of the ports may be read via the handset using the IOP command. The active and inactive states are configurable for each individual input by choosing whether or not to invert them. Normally, '1' is an open circuit for vehicle detectors.

15.4 PORTS

The ports of the controller provide a means of connecting the hardware of the input and output signals to the controller software.

Each port consists of 8 bits (0 to 7) which must be either all inputs or all outputs.

In order to calculate the number of ports that are required, the inputs and outputs are allocated, where practical, into groups of 8. It is better for configuring if all the detectors for one phase are on the same port.

UTC inputs must be allocated different ports to detector or other inputs for software reasons.

15.5 PROVISION OF I/O ON EXPANSION I/O, MAIN PROCESSOR AND SDE/SA BOARDS

There are 16 input lines and 16 output lines available on each Expansion I/O Board. All lines on the board are buffered.

Up to three Expansion I/O Boards (i.e. boards 0, 1 and 2) may be fitted in the PCB module, with a total of 12 ports available as detailed in section 15.7.

When the SDE/SA facility is used, the input ports required for the assessors are contained on a special SDE/SA PCB which is situated beside the Expansion I/O Board(s). In this case expansion board 1 is not available.

The SDE/SA PCB consists of 4 input ports (port numbers 6-9) which provide 32 buffered inputs and consequently 16 assessors (see section 6). Any unused inputs may be used for other inputs.

The Main Processor Board provides 4 buffered input lines, 12 unbuffered input lines and 4 buffered output lines.

The ports on the Expansion I/O, Main Processor and SDE/SA PCBs are accessed by sockets on the rear. The Expansion I/O Board has 4 sockets, the Main Processor has 2 and the SDE/SA PCB has 2.

15.6 INTERFACING

Normally equipment is connected to the controller inputs via the controller Expansion I/O Boards, which isolate the controller logic from the outside world. However, if the equipment is within the controller cabinet, it is possible to connect directly to the controller Main Processor unbuffered inputs without going via Main Processor buffered inputs or Expansion I/O Boards.

Note: Unbuffered inputs MUST NOT be connected to any equipment external to the outercase.

This is only possible if the device to be connected to the controller input has isolated (voltage free) reed relay contacts, or the Solid State equivalent, as an output with the following impedance characteristics.

Device output low impedance:	< 2K ohms
Device output high impedance:	> 300K ohms

This will not operate within a standard solid state output as specified in MCE0100.

Such output contacts may be commoned to Controller 0 volts if required.

N.B. Controller inputs, both buffered (I/O Card) and unbuffered (CPU Card input bits 4 to 15) may be connected to an internally mounted Siemens Outstation Monitoring Unit. This may not be true for other makes of OMU.

15.6.1 Cable Assemblies

A cable assembly consists of a cable with one or two 12-way terminal blocks on one end and a plug for connection to an Expansion I/O Board, SDE/SA Board or Main Processor Board at the other.

The following types of cable assembly are normally used:

a) One terminal block and a plug for a single 8-input only port (two buffered, six not) into PLE of the Main Processor Board.

b) Two terminal blocks and plugs for a 16-input only port (two buffered, fourteen not) into PLE of the Main Processor Board.

c) A terminal block at one end and discrete Berg pins at the other for inserting into the Main Processor Board Output port (PLC - 4 reed relay outputs).

d) Two terminal blocks and plugs for connection to Expansion I/O Boards or SDE/SA Boards.

There is a short and long version of each type of cable assembly to allow for the different positions of the terminal blocks.

15.6.2 Extended System Bus

A ribbon cable is used to interconnect the Main Processor Board and the Expansion I/O Boards and/or SDE/SA PCB via the Extended System Bus connectors.

15.7 PORT ALLOCATION

Port numbers are allocated as per the following table:

Board Type	Port No	Port Type	Connector name
CPU	0	INPUT	PLE
CPU	1	INPUT	PLE
CPU	11*	OUTPUT	PLC
Expansion I/O	(a)	INPUT	PLB
Expansion I/O	(b)	INPUT	PLC
Expansion I/O	(c)	OUTPUT	PLE
Expansion I/O	(d)	OUTPUT	PLD
SDE/SA	6	INPUT	PLB
SDE/SA	7	INPUT	PLB
SDE/SA	8	INPUT	PLC
SDE/SA	9	INPUT	PLC

Where a, b, c and d are:

	Expansion I/O Board 0	Expansion I/O Board 1	Expansion I/O Board 2		
a	2	6	10		n/a
b	3	7	11*	or	n/a
c	4	8	n/a		10
d	5	9	n/a		11*

The Expansion I/O Board no. is indicated on the rotary switch on the front of each board.

* Port 11 can be defined as either 4 bits of output (on the main CPU board) or 8 bits of input or output (using Expansion I/O board 2).

The following figures will assist when allocating the ports:

Figure 15.1 - BLOCK DIAGRAM OF MAIN PROCESSOR BOARD
Figure 15.2 - PCB POSITIONS AND LAYOUT OF PHASE DRIVER RIBBON CABLES
Figure 15.3 - REAR VIEW OF PCB I/O CONNECTIONS (T400 LARGE SHOWN)
Figure 15.4 - TERMINAL BLOCKS IN SMALL CONTROLLER
Figure 15.5 - TERMINAL BLOCKS IN LARGE CONTROLLER
Figure 15.6 - TERMINAL BLOCKS IN LARGE CONTROLLER (HONG KONG)

Figure 15.1 - BLOCK DIAGRAM OF MAIN PROCESSOR BOARD

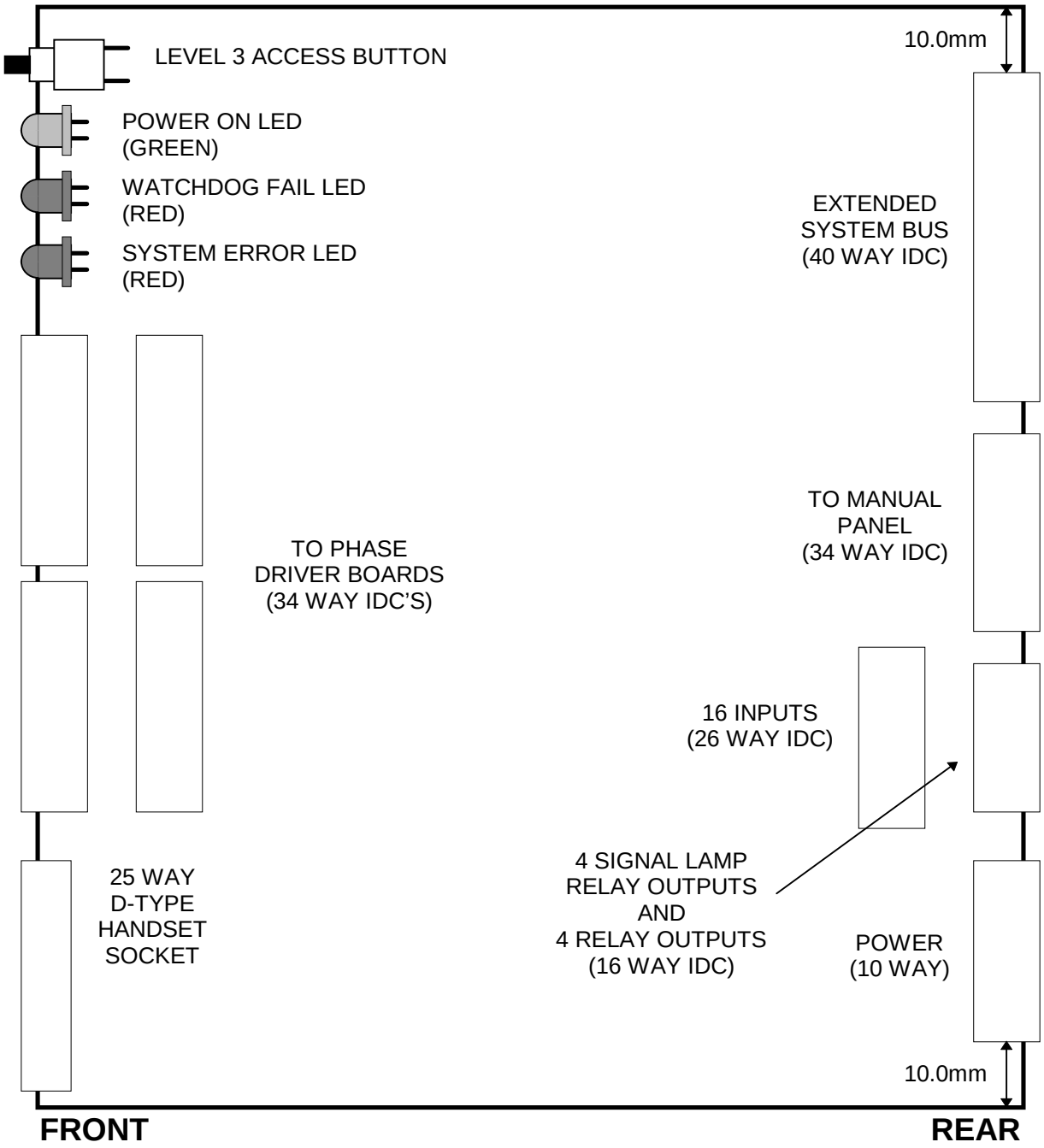


Figure 15.2 - PCB POSITIONS AND LAYOUT OF PHASE DRIVER RIBBON CABLES

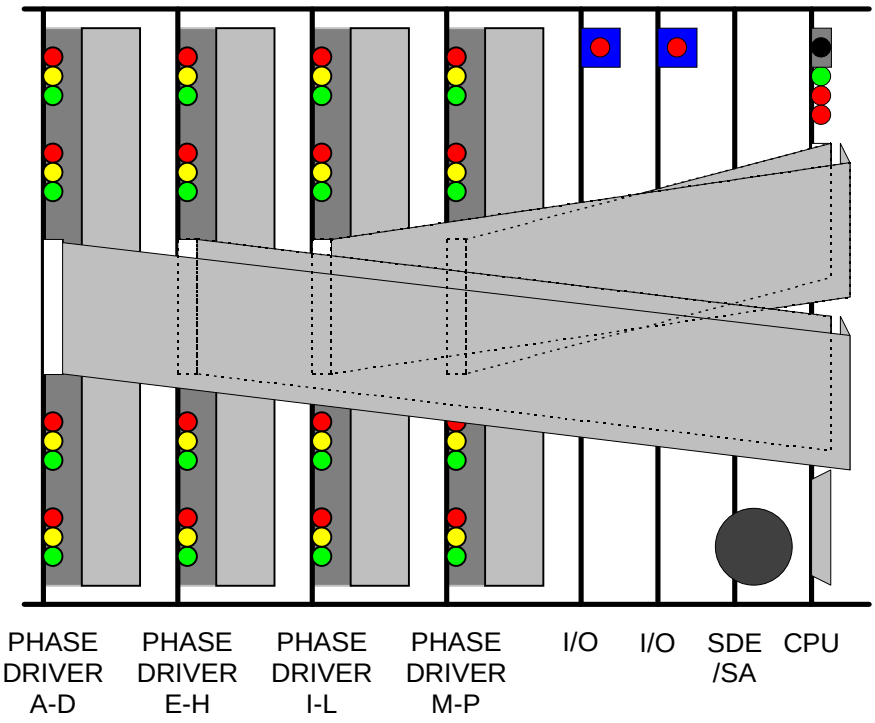


Figure 15.3 - REAR VIEW OF PCB I/O CONNECTIONS (T400 LARGE SHOWN)

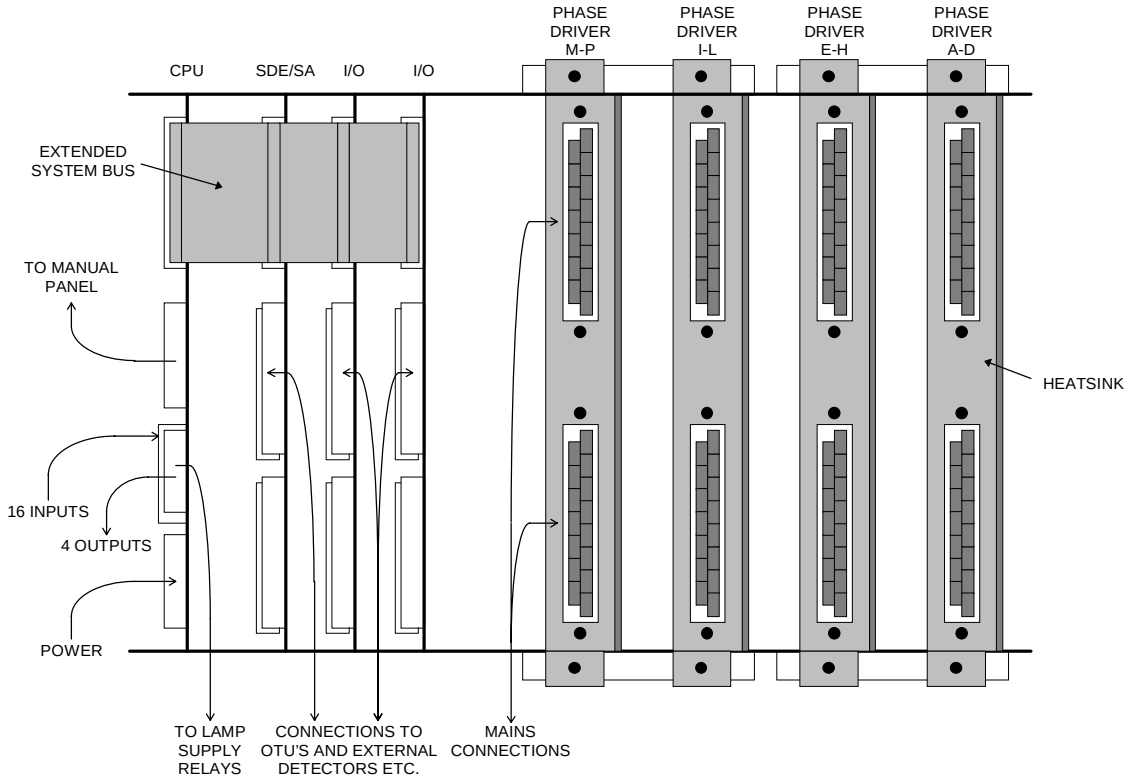


Figure 15.4 - TERMINAL BLOCKS IN SMALL CONTROLLER

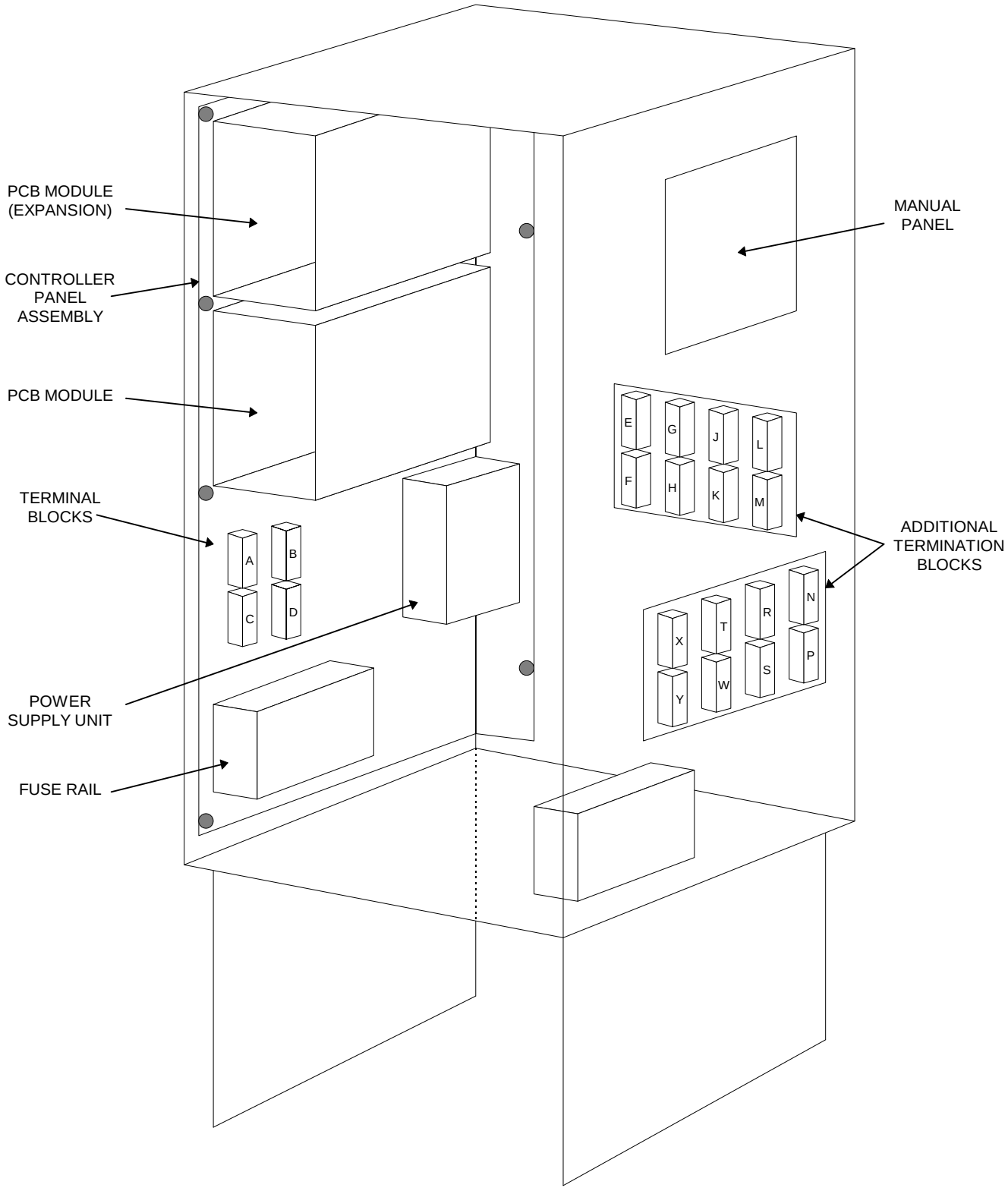


Figure 15.5 - TERMINAL BLOCKS IN LARGE CONTROLLER

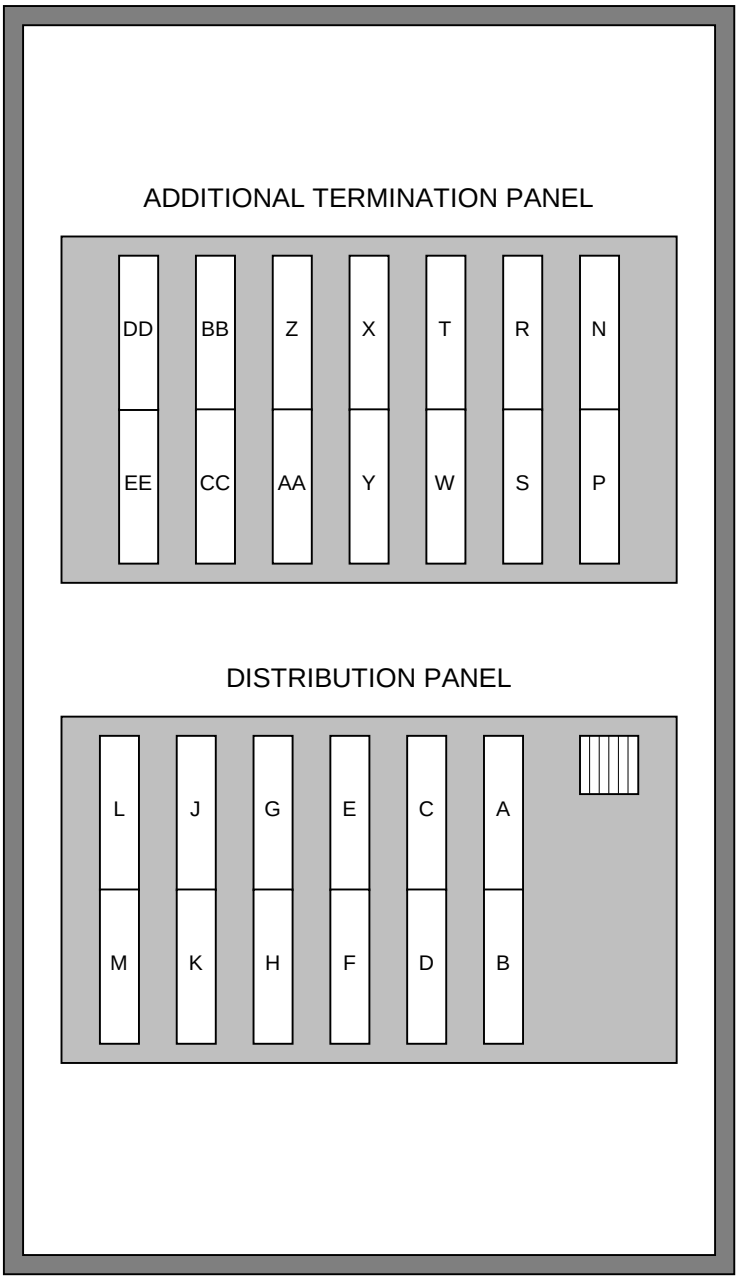
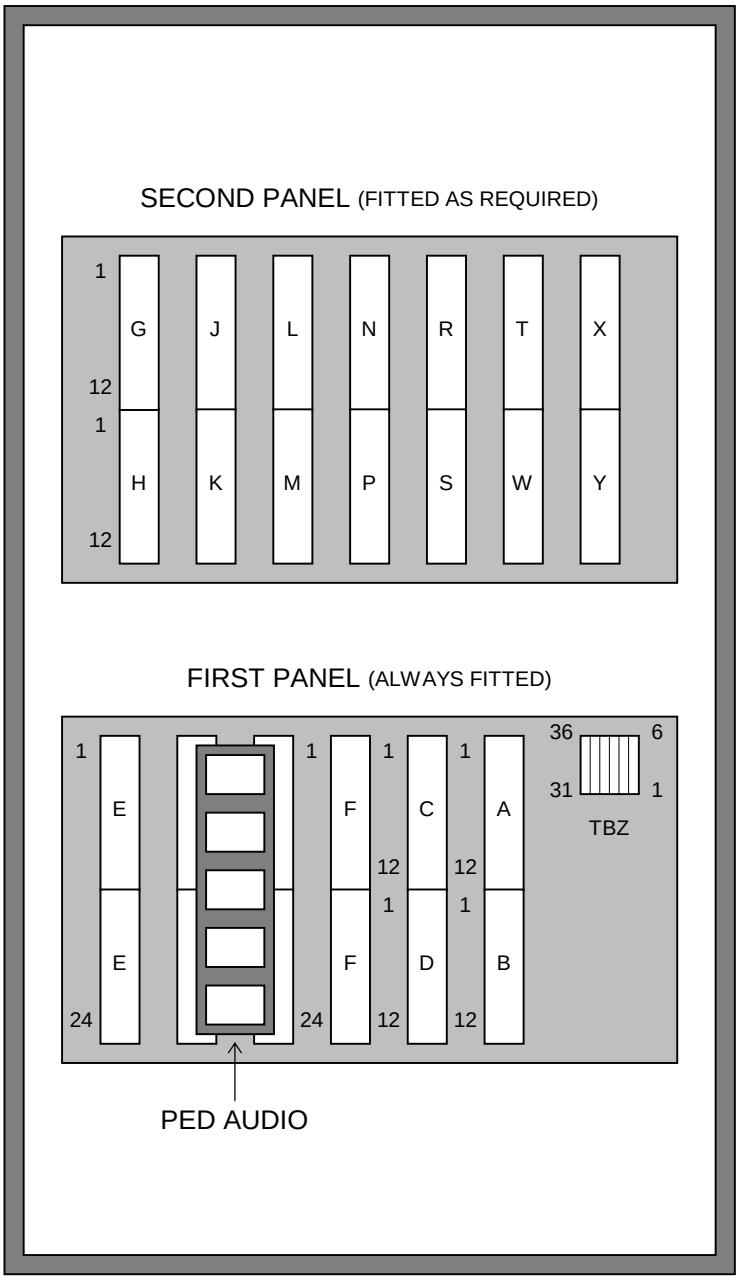


Figure 15.6 - TERMINAL BLOCKS IN LARGE CONTROLLER (HONG KONG)



15.8 'DET' HANDSET COMMAND

Each bit of each port has an I/O line number which is used as the index for the DET handset command and other similar commands.

The Det. Reference numbers are as follows:

PORT	DET
0	0-7
1	8-15
2	16-23
3	24-31
4	32-39
5	40-47
6	48-55
7	56-63
8	64-71
9	72-79
10	80-87
11	88-95

The normal DET setting for an input or output line is Code '2'. This allows the input or output to operate normally. The state may be configured to '0' or '1' if required.

'0' will set the input or output permanently inactive while '1' will set it permanently active. The setting of '0' or '1' will force DFM to treat the input as if it is always changing state and thus DFM is effectively disabled on that input.

Whichever state is programmed may be changed via the handset using the DET command.

Note: the DET command cannot be applied to SDE/SA ports, although it can be applied to ports on the SDE/SA board which are not used for SDE/SA.

If having set inputs and/or outputs permanently active or inactive, you wish to set all inputs/outputs back to 'normal' operation, i.e. reacting to internal or external influences as normal, then just enter "DET 0=99".

The DET command may be used to introduce, delete or override certain facilities by using the handset.

To introduce or delete a facility, the controller is programmed so that the facility will only be effective if a nominated input is active. The setting of the input active, i.e. '1', will introduce the facility, while setting it inactive or normal, i.e. '0' or '2', will delete the facility.

An example of this is a stage that is required not to appear initially. The stage is prevented from appearing while the input is active. When the input is set inactive or normal then the stage will be allowed to appear.

To override a facility, the controller is programmed so that the facility will be effective when the correct conditions occur or a nominated input is set active.

An example of this is flashing amber signals at night time. The setting of the input active will override the timetable setting and introduce the facility.

15.9 DETECTOR FAULT MONITORING (DFM)

DFM is allocated to specified detector inputs and, if required, pedestrian push-button inputs.

If an input does not change state, i.e. is permanently active or permanently inactive, for a specified period then the DFM will time out.

When the DFM times out the following happens:

(i) the cabinet alarm lamp situated in the manual panel door is illuminated.
(ii) the input will be either be used as before, forced active or forced inactive as selected on the configuration sheet (see example Figure 21.7). This selection can be altered via the handset.
(iii) the appropriate fault log will be set

If the input then subsequently changes state and the DFM Reset push-button (if fitted) on the Manual panel is operated or the RDF command handset is used before the DFM timer times out again. Then the cabinet alarm lamp will be extinguished and the input will resume normal operation. The fault log will not be reset until the appropriate command is entered via the handset.

If the detector fault cannot be immediately repaired, then to clear the cabinet alarm lamp and any DFM reply to the central office, and allow further faults to be indicated. Do the following:

Use the ‘ADF’ command to accept the detector faults. This only removes the already faulty input from DFM consideration, any faults on other inputs will still be flagged up.

N.B. After using ‘ADF’ DO NOT press DFM reset button on the manual panel or use ‘RDF’, otherwise DFM timer may reset and monitoring will resume on faulty input giving repeat fault indications.

After having used ‘ADF’ and removed external fault indications (i.e. Fault log remains intact). Use the appropriate ‘DET’ command to set the relevant input permanently active, i.e. DET? = 1 where ? is the relevant DET number. This will provide a permanent demand or extension as necessary.

15.9.1 DFM Timing

15.9.1(a) Option 1

The timing range of the DFM is 0 to 255 hours in 1 hour steps, although the normal time is 9 or 18 hours. The programmed value may be changed via the handset using the DFD command.

Figure 21.7 shows an example configuration sheet including selection of the DFM time, the selection of inputs covered by DFM, and the action on DFM timeout.

15.9.1(b) Option 2

The inputs are assigned to one of eight groups. Each group is allocated to a separate 'Stuck active' and 'Stuck inactive' time.

The timer for each input resets when the Detector changes state. It is possible to introduce up to four threshold limits (as shown in the example below), and if the timer value is greater than the threshold, a fault is reported straight away.

Note that short DFM periods should not be introduced at the same time as demand is expected to increase, but some time later to allow for the fact that the timer value may already have been exceeded.

Each input will be individually timed and checked against the timeout value, The timeout values are:

Stuck Active time.....1 to 254 minutes

Stuck Inactive time.....1 to 254 Hours

The DFM Group times can be adjusted by the handset subject to configured limits for the Active and Inactive times.

Additional Handset commands are available for this facility, see T400 Handset Handbook 667/HH/20200/000

EXAMPLE:

	Timeset A		Timeset B		Timeset C		Timeset D	
	A	I	A	I	A	I	A	I
DFM Group 0	60	2	30	4	30	4	30	4
DFM Group 1	30	9	30	18	15	9	255	255
etc....								

In the above example:

'A' is the Active State (Measured in minutes).
'I' is the Inactive State (Measured in hours).

The DFM will time out for detectors in Group 0 during time set A as follows:

If the detector is active for greater than 60 minutes.
If the detector is inactive for greater than 2 hours.

Note that in Group 1 during time set D, the value is 255, this disables the DFM timer.

15.9.2 Switched DFM

It is possible for a detector or pedestrian push-button to have switched DFM, i.e. at certain times of day the DFM facility is removed.

To achieve this, two inputs are required for each detector or pedestrian push-button requiring the switched DFM.

One input has DFM associated with it and the other one does not. The inputs are then switched inactive by timetable settings such that only one input is operational at any time of day.

Special Conditioning Software is necessary to prevent the inactive inputs DFM function from timing off. See section 12.3.

This facility is implemented in firmware for later issues of PB321 firmware. See Option 2 Section 15.9.1.

15.9.3 Cabinet Alarm From Special Conditioning

The Cabinet Alarm LED can be controlled from Special Conditioning. The Special Conditioning output is OR-ed with the normal DFM output, so either active output will light the led. If the Cabinet Alarm flashes due to a red lamp failure report from an LMU, then the outputs from Special Conditioning and the normal DFM are ignored.

15.9.4 Fixed I/O for specific contracts

Certain contracts require that the Controller Inputs and Outputs be fixed for all Controllers. This is achieved by entering dummy inputs/outputs at the time of configuration.

16. MANUAL PANEL

See Figure 16.1.

16.1 STANDARD FACILITIES (Intersection Controller)

16.1.1 Stage Selection Push-Buttons

There are 8 stage selection push-buttons (0 to 7) available for use during Manual mode.

Push-button 0 is normally allocated to Stage 0, the manual all-red facility, and is designated ALL RED.

Push-buttons 1 to 7 may have any 7 of the remaining 15 stages allocated to them.

Figure 21.5 indicates where to request the allocations.

16.1.2 Mode Select Pushbuttons

When the NORMAL mode select pushbutton is pressed, the highest priority mode with operating conditions active will be the current mode.

Selection of MANUAL, VA, CLF or FIXED TIME will cause those modes to become operational providing no higher priority mode is active. (See also section 9.12).

16.1.3 Signals OFF/ON Switch

When the OFF position is selected the signal lamps will be extinguished immediately regardless of their current state. While the signal lamps are extinguished the controller will continue to function.

When the ON position is selected the signal lamps will be illuminated immediately at whatever point the controller has reached, or go through a start-up sequence, depending upon configuration.

16.1.4 SW1, SW2 and SW3 Pushbuttons

The function of these switches can be set up in configuration for such facilities as Dim Override, DFM Reset or Part-Time mode, etc. (see below).

16.1.5 Lamp Dim Override Switch (If Configured)

The LAMP DIM OVERRIDE switch gives two situations, NORMAL or BRIGHT.

When the switch is in the NORMAL position the Signals Dimming facility will operate normally.

When the switch is in the BRIGHT position the Signals Dimming facility will be overridden.

16.1.6 DFM Reset Push-button (If Configured)

The DFM RESET push-button extinguishes the CABINET ALARM lamp, providing the DFM failure causing the alarm indication has been cleared. This push-button also re-establishes fault monitoring for detector inputs overridden via the handset using the ADF command.

16.1.7 Lamp Test Push-button

The LAMP TEST push-button applies a signal which illuminates all indicators on the Manual panel and illuminates the CABINET ALARM lamp for test purposes.

16.1.8 Manual Button Indicators

The Manual Button Indicators are for use during Manual mode. They generally indicate the number of the current stage selected, but see section 9.6.2.

These indicators are only illuminated when manual mode is in operation or when the handset is plugged in.

16.1.9 Awaiting Command Indicator

When Manual mode is operative, the AWAITING COMMAND indicator illuminates when a stage change is permitted, i.e. the minimum green periods for the phases in the current stage have expired (see section 3.5.1).

16.1.10 Prohibited Move Indicator

When Manual mode is operative the PROHIBITED MOVE indicator illuminates if the selected stage is prevented, deleted by the master time clock or if the move is prohibited.

16.1.11 Hurry Call Active Indicator

This is illuminated immediately a valid Hurry Call is received and remains illuminated until the end of the hold period even if Hurry Call mode is not the current mode due to a higher priority mode being active.

16.1.12 Higher Priority (UTC) Active Indicator

This is illuminated whenever the current operating mode is higher priority than manual mode (this could be due to UTC bus priority etc.).

16.1.13 Spare Indicators

There are three indicators (AUX1, AUX2, AUX3) whose function can be set up in configuration, e.g. to indicate when an input to a Priority Unit is active, UTC active, Remote Reconnect, Dim override, Alternative Maximum, Audio override, Barrier Up, Continuous Demands and/or Extensions, Green Wave etc.

If more than three indicators are required, then the HURRY CALL active or HIGHER PRIORITY active indicators may be used if they are not required for their normal use. Another use is to indicate the state of the switches SW1, SW2 and SW3, e.g. to show if Dim Override is active or not.

SW1, SW2 and SW3 can be used to implement optional manual facilities such as:

Dim Override.
DFM Reset.
Part Time (Export only).
Signals Flash (Export only).
Alternative Maximum.
Override Audio Signal.
Diversion.

Refer also to 667/2/20645/000 (T400 Manual Panel Labels)

16.2 HONG KONG INTERNAL MANUAL PANEL

See Figure 16.2.

The internal Manual Panel used on T400s supplied to Hong Kong are similar to the standard item although they are housed internally, with different silk-screening and are mounted horizontally. The following sections describe the differences.

16.2.1 Signals OFF/ON Switch

This is not mounted on the Internal Manual Panel - it is mounted on the Police Manual Panel behind the Manual Access Door. Its function is unchanged from the standard item.

16.2.2 SW1, SW2, SW3 Pushbuttons

SW1 and SW2 are pre-allocated to Override Dim and Flash Signals and are silk screened accordingly. SW3 is not present.

16.2.3 Lamp Dim Override switch

There is no Lamp Dim Override switch, a pushbutton being provided instead (see above).

16.2.4 Spare Indicators

There is only one spare indicator - AUX3.

16.3 PELICAN MANUAL PANEL

The Manual Panel used on a Pelican controller is essentially a reduced version of the Intersection Panel, with the exception that the mode select buttons are replaced by 'Cont Ped Demand', 'Cont Vehicle Extend' and a 'Select' button for toggling between 'VA' mode and 'Fixed Vehicle Period' mode, see Figure 17.1.

For a full description of the Pelican Manual Panel, see section 17.3.

16.4 EXTRA FACILITIES

16.4.1 Basic Manual Panel

If the manual panel is not required, then it can be replaced by a basic manual panel which only contains a SIGNALS OFF/ON switch and CABINET ALARM LED (See Figure 17.2). When this is used, handset commands are available for the selection and display of Manual Facilities.

16.4.2 Fixings for BT Terminations

Modifications can be made to the manual panel to fit different types of British Telecom (BT) terminal boxes.

The following types of BT terminal boxes can be fitted to the Manual Panel plastic shroud:

(i) Type 14A
(ii) Type 35A
(iii) Type 14A and Line Jack Unit 1A

Figure 16.1 - MANUAL PANEL

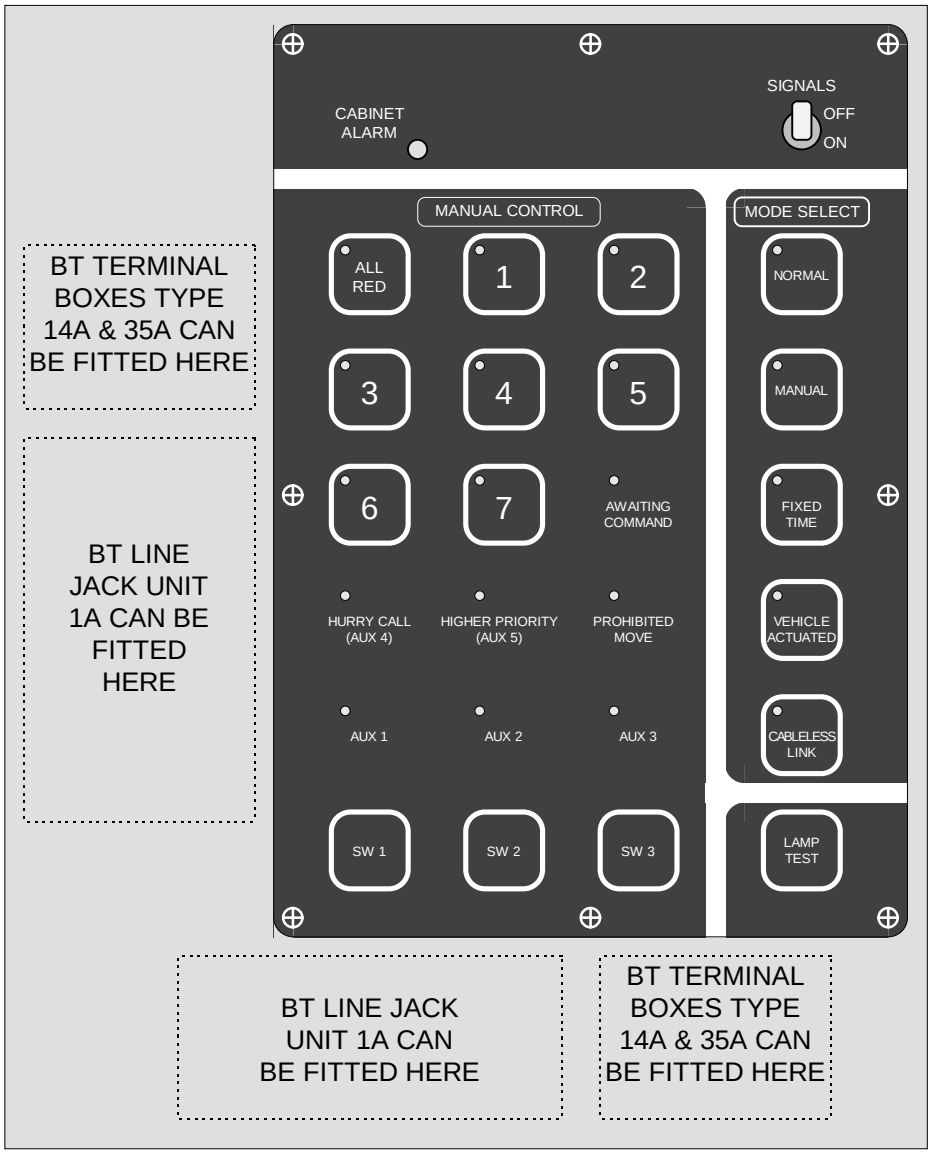
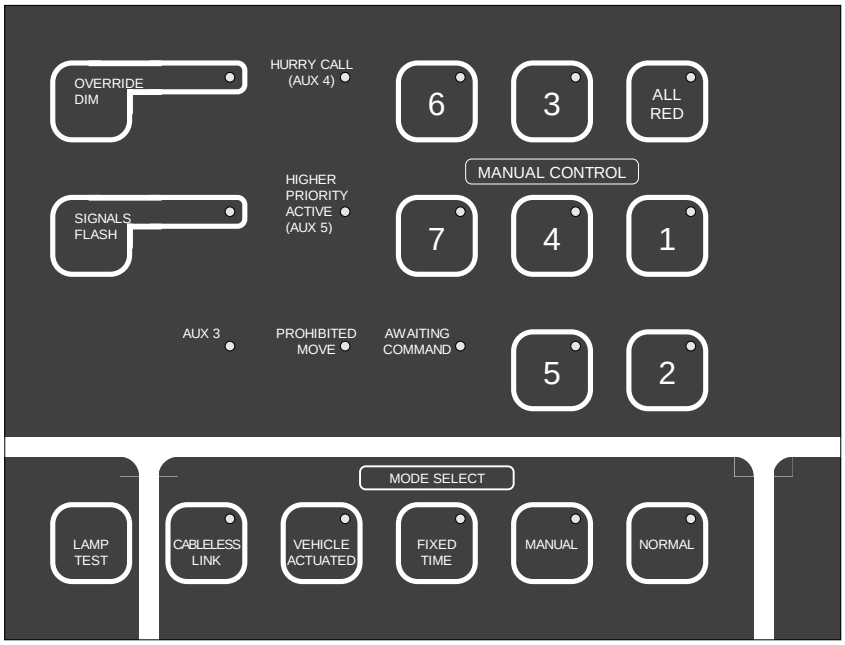


Figure 16.2 - INTERNAL MANUAL PANEL (HONG KONG)



17. PELICAN/PEDESTRIAN CONTROLLER

17.1 GENERAL

There are a number of pelican configuration PROMs which define the basic operation, e.g. single or dual, MCE0125 or MCE0145, Puffin or Toucan, etc...

One of these basic configurations is selected for the controller and it is further altered via the handset, i.e. timings may be altered within approved ranges, IO lines on the controller may be set up to have different functions, etc. Selection of some facilities may require extra hardware, e.g. extra Expansion I/O card. Timings and selections made via the handset are stored in battery backed RAM which is continually validated by CRC checking. If the check fails an entry is made in the fault log and all lamps are switched off. Manual intervention (i.e. RFL=1) and Power OFF/ON is required before the lamps will come on again.

Further details of the pelican configuration PROMs and the facilities supported by particular firmware types & issues can be found in 667/SU/20200/000 which is included in the General Handbook.

There are two modes of operation of a Pelican/Pedestrian controller:

17.1.1 Fixed Vehicle Period Mode

In this mode, the controller runs a set Vehicle Green period (ranging from 20 to 60 seconds in 1 second increments) after which it will service a pedestrian demand if one exists. If no pedestrian demand is present it will rest on vehicle green until there is a ped. demand which it will then service immediately.

17.1.2 Pelican VA Mode

In VA mode, the controller will respond to vehicle extension detectors (once the minimum vehicle green has expired) in the following manner:

17.1.2(a) Extending/Maximum Change

If a pedestrian demand is inserted but vehicles are passing continuously over the detectors, the vehicle green will be extended to a preset maximum, after which the pedestrian demand is serviced. In this instance, for safety reasons, a “maximum change” all-red period will be inserted between the vehicle green and the pedestrian green after the amber leaving period. If no pedestrian demand exists, the vehicle max. green timer will not be started and the vehicle phase will rest in green.

17.1.2(b) Gap Changing

If a pedestrian demand is inserted where vehicles are not passing continuously over the detectors, the controller will wait until no vehicle extensions are being timed and then service the pedestrian demand, before the vehicle green max. timer has timed out. In this instance, a “gap change” all-red period alterable between 1 and 3 seconds, is inserted between the vehicle and pedestrian greens.

17.1.2(c) Pre-timed Maximum Vehicle Green

This is an alternative form of VA mode if selected, the controller will start the max. vehicle green timer as soon as vehicle green is gained, instead of waiting for an opposing/pedestrian demand. If no pedestrian demand occurs before the max timer expires the controller will rest in vehicle green until a pedestrian demand is inserted which it will then service immediately by completing a "max change" to pedestrian green, even if a vehicle is inserting a continuous extension. If a pedestrian demand is inserted before this max. timer has expired there can still be a gap change if there are no vehicle extensions present.

17.1.3 Short Vehicle Green via UTC

When operating in Fixed Vehicle Period mode the Pelican can be forced, via the UTC, to run VA mode; which will give a vehicle green of 6 to 15 seconds (assuming no extensions). The following steps need to be taken:

(1) Enable VA mode via the handset and manual panel.

(2) Invert the inputs allocated to 'UTC switch to FVP' signal (UTCFVP) using the appropriate handset command.

(3) On setting UTCFVP active the Pelican will be forced to stop running Fixed Vehicle Period and VA will become active.

17.2 PELICAN/PEDESTRIAN TIMINGS

The minimum green, maximum green and vehicle extension timings for a pelican are alterable via the handset within ranges approved in MCE 0125 and MCE 0145. These are different to those for MCE 0141 vehicle phases and thus they are accessed by different handset commands.

There are other alterable timings for the all-red time from vehicle green to ped. green in UTC and Local Link modes following the removal of PV and PV1 respectively. If both of these signals occur simultaneously then the UTC signal PV always overrides the Local Link signal.

If SDE/SA is selected (via the handset) and fitted on the controller, then all of the vehicle green to pedestrian green all-red times are fixed at three seconds.

If there has been a DFM failure on the controller, then a maximum all-red time is included in the change from vehicle green to pedestrian green for safety reasons.

If the Vehicle Detector Checking facility has been enabled and there has been no activity on one or more of the vehicle extension during the vehicle green period, then a maximum all-red time is included in the change from vehicle green to pedestrian green for safety reasons.

17.3 MANUAL PANEL FACILITIES

A different manual panel is required for the T400 when used as a Pelican controller instead of as an intersection controller. Two options are available Standard and Basic. The overlays for these panels are shown in Figure 17.1 and Figure 17.2 respectively. A brief description of the function of each of the switches follows:

17.3.1 Select VA/FVP

The mode on the pelican/pedestrian controller may be selected between FVP and VA. However the Select VA function is only actioned if VA mode has been enabled via the handset. The associated LED reflects the position of the pushbutton only and this is not necessarily the mode that is currently running.

17.3.2 Continuous Ped. Demand

When this button is pushed, the associated LED is illuminated and a permanent demand is inserted for the pedestrian phase of that pelican stream.

17.3.3 Continuous Vehicle Extension

When this button is pushed, the associated LED is illuminated and the vehicle extension timers are continually reset so that in VA mode the vehicle phase always runs to a max. When this switch is released, the extension timer running continues to time out and after it has expired, the pelican stream reverts to normal operation.

17.3.4 DFM Reset

This button is used to reset the DFM lamp and only has that effect if all faulty detectors/pedestrian pushbuttons have changed state since the fault was registered.

17.3.5 Auxiliary LEDs (AUX1/AUX2/AUX3) and Switches (SW1/SW2/SW3)

There are two functions available which may be assigned to any of these three switches and LEDs. The requirements in terms of switches and LEDs for these two functions are given below:

Remote Reconnect	:	Both a switch and LED are required.
Computer Control LED	:	LED alone is required.

NOTE: When a Basic panel is used the manual Panel facilities are available via the handset.

17.4 HANDSET

On street selection of pelican facilities by the handset can be carried out. A list of the pelican handset commands is given in section 8 of the Handset Handbook, 667/HH/20200. The following settings can be altered on the pelican controller:

17.4.1 Timings

Handset commands are provided to control the pelican timing steps separately from the intersection timings.

Use of the intersection timing commands (e.g. MIN, MAX, EXT, IGN, IGS etc.) have no effect on the pelican timings.

Local linking times for link delay, link window, override and link fail times are also alterable on the handset.

17.4.2 Speed Discrimination (SDE/SA)

No SDE/SA operation, Double or Triple SDE or SA operation and the number of speed assessor units required for the Pelican/Pedestrian may be selected via the handset.
Both of the standard PROMs have capability for SDE/SA facilities but only for the DTp standard loop spacing of 12ft.

17.5 I/O LINE ALLOCATION

Each of the following functions may be allocated to an I/O line:

Input functions

- UTC ped. inhibit PV
- UTC ped. demand PX
- UTC take over TO (enable SC, PV, PX)
- UTC switch to FVP working
- UTC switch to alternative timings
- UTC Dim Override / remote dim control DO
- UTC vehicle extensions inhibit SC
- UTC RTC Sync. bit, UTCTS
- UTC fall back mode FM
- local link disable LL
- local link ped. inhibit PV1
- local link ped. demand LD
- call/cancel ped. demand CC
- 3 vehicle extension detectors
- 2 push button ped. demand (4 on PB322 issue 2 and higher)

Output functions

- UTC vehicle green confirm GX
- UTC wait indicator confirm WT
- UTC ped. green confirm PG
- UTC RTC Reply, UTCCS
- UTC fall back confirm FC
- DFM fail confirm DF
- UTC signals off confirm SO
- local link disable confirm LL
- UTC bright confirm SOC
- remote reconnect RR (active state = disconnect)
- link out (vehicle green confirm)
- link out (bright confirm)

A description of each of these I/O functions is given in Section 17.10 and the Works Specification defines which functions are defaulted to which I/O line.

In addition it is possible to:

(a) enable/disable DFM on each input.

(b) define the action taken when DFM on an input detects a fault as:
- continue to use input as before.
- override input state to active.
- override input state to inactive.

(c) invert the sense of particular inputs.

(d) define number of red lamp monitor channels used on each pelican/pedestrian traffic phase.

NOTE: All outputs are defaulted as open contact for active.

17.6 WAIT INDICATORS

This facility allows the user to select (via the handset) whether the wait indicator is illuminated by any of the following demands:

- Pushbutton ped demands
- UTC ped demands
- Manual Panel ped demands
- Local Link ped demands
- Handset ped demands

17.7 AUDIO CONTROL AND MONITOR

An output activates the audio unit during the ped. steady green time (MCE0125 only). An input monitors the drive voltage to the audio unit and a check is made that the monitored state corresponds with the requested state. Repeated failure of the check causes the lamps to be turned off within 500mS (from the point at which the first occurrence of the fault was detected) and an entry made in the fault log. Since the audio drive is derived from the pedestrian green supply, turning the signals off removes the audio drive.

These is one audible drive circuit per 2 phase driver board, and each can drive upto 6 audibles (assuming each is 2kΩ).

In the interests of safety, when the audibles are off, one set of relay contacts 'short' the cable pair driving the audibles, and the other set connects a 1kΩ resistor across the supply driving the audibles.

This audio drive can also be used to control Tactile Units, see Figure 18.3.

17.8 GREEN CONFLICT FAULT ACTION

On detection of a green conflict (as indicated by monitoring the output of the green conflict PROM) the controller turns all the controller lamps and audio indicators off. The lamps will remain off until manually reset, using the handset, turning the power off and then restoring the power.

17.9 RED LAMP MONITORING

The each pelican stream has upto four seperately monitored vehicle red drives, known as the four red lamp monitor 'channels'. The current flowing through the vehicle red lamps is monitored to check that there is at least one vehicle red lamp showing per channel while there is a steady green signal showing to pedestrians. If a fault occurs, the controller turns the signals and the audio indicators off for that pelican stream. The lamps will remain off until manually reset, using the handset, turning the power off and then restoring the power.

17.10 DESCRIPTION OF I/O LINE FUNCTIONS

Pelican I/O Summary

Control Bits UTC

Title	Bit Designation (if any)
UTC Pedestrian Inhibit	(PV)
UTC Pedestrian Demand	(PX)
UTC Transmission Confirm	(TC)
UTC Takeover Control	(TO)
UTC Dim Override/Local Link Dim Request	(SO)
UTC Fall Back Mode	(FM)
Vehicle Extensions Inhibit	(SC)
Real Time Clock Sync	(TS)
Computer Control LED on Manual Panel	( )
Switch to FVP mode	( )
Switch to Alternative Timings	( )
Local link Disable	(LL)

Reply Bits UTC

Title	Bit Designation (if any)
Vehicle Green Confirm	(GX)
Wait Indicator Confirm	(WT)
Pedestrian Green Confirm	(PC)
DFM Fail Confirm	(DF)
Signals Off Confirm	(LE)
Local Link Disable Confirm	(LL)
UTC Bright Confirm	(SOC)
Remote Reconnect	(RR)
Real Time Clock Sync. Reply	( )
Fall Back Confirm	(FC)

Local Link Facilities

Title	Bit Designation (if any)
Local Link Ped. Inhibit	(PV1)
Local Link Dim Request	( )
Local Link Ped. Demand	(LD)
Link Out (Vehicle Green Confirm)	( )
Link Out (Dim Request)	( )
Call/Cancel Ped. Demand	(CC)

17.10.1 UTC Facilities (Control Bits)

UTC Ped. Inhibit (PV)
This input signal prevents the pedestrian phase on a pelican. When PV is released, vehicle extensions will be inhibited for a period specified via the handset (UIE). Even if PV is reapplied during this period it will have no effect.

UTC Ped. Demand (PX)
This input signal puts in a request for the pedestrian stage of a pelican.

Vehicle Extensions Inhibit (SC)
This input signal forces the controller to ignore all vehicle extension requests. To ensure safety of operation, the vehicle to ped. change becomes a UTC. all-red change rather than a gap change. The UTC all-red change time is alterable via the handset.

Real Time Clock Sync.
This input causes the Real Time Clock to synchronise to 12:00:00 hrs each day.

UTC Transmission Confirm (TC) or Takeover Control (TO)
The TC signal, if allocated to an I/O line, is transmitted to the controller from the OTU if valid data has been received by the OTU. The TO signal is very similar in effect except that it is transmitted from the UTC Central Office and not from the OTU and it too signifies that valid data is being sent by the UTC Central Office. The presence of either of these signals disables the Local Link facility.

Computer Control LED on the Manual Panel
The rules governing the illumination of this LED are as follows:

(1) If the TC/TO function has not been assigned to an IO Line then the presence of PV alone lights this LED.

(2) If TO has been assigned to an I/O line then the LED is only illuminated when TO is present in conjunction with PV.

(3) If TC has been assigned to an I/O line and selected to control the LED, then the presence of this TC signal alone lights the LED.

(4) If TC has been assigned to an I/O line and selected not to control the LED, then the LED is illuminated only when both PV and TC are present (as in case 2).

Switch to FVP mode
This input disables Pelican VA mode and thus forces the controller to run in FVP mode. This signal only has an effect when the Pelican is running VA mode which happens when:

(a) VA operation is selected via the handset.
AND (b) the mode requested by the VA select button on the manual panel is VA.

Switch to Alternative Timings
This input signal forces the Pelican to switch to the first alternative set of timings (for vehicle green max time and FVP time only).

UTC Dim Override (SO)/Local Link Dim Request
One of these two types of remote dimming can be selected via the handset for the pelican/pedestrian. The main difference between the two types is:

- the UTC input signal overrides any request for the controller to be in the dim state provided by the solar cell output and thus provides a "Bright Request" signal.
- the Local Link Dim Request signal is required for a slave pelican controller in a linked dimming situation and provides a "Dim Request" signal. This means that a master controller which has a solar cell controlling its dimming facility may be able to pass on its dim/bright state to another (slave) controller without a solar cell.

Local Link Disable (LL)
The effect of this input signal is to disable the Local Link Pedestrian Inhibit facility (PV1) which is detailed in section 17.10.3. This signal is not required for UTC Control as the removal of PV inhibits PV1 as well as extensions during the window time (UIE).

Fall Back Mode (FM)
This causes the Pelican to disable C.L.F. mode whilst the FM bit is true/active. Thus, if higher modes are not requested, the pelican will work in the next mode below C.L.F. in the priority table, normal VA or FVP.

17.10.2 UTC Facilities (Reply Bits)

Vehicle Green Confirm (GX)
This output signal indicates that the vehicle phase is showing green on the street. This output signal must always be assigned to a Normally Closed relay so that it fails to the inactive (closed contact) state.

Wait Indicator Confirm (WT)
This output signal indicates that the Wait indicator for the pedestrian phase is illuminated on the street. This output signal must always be assigned to a Normally Closed relay so that it fails to the inactive (closed contact) state.

Pedestrian Green Confirm (PC)
This output signal indicates that the pedestrian phase is showing green on the street. This output signal must always be assigned to a Normally Closed relay so that it fails to the inactive (closed contact) state.

DFM Fail Confirm (DF)
This output signal indicates when the DFM lamp has been illuminated. This output signal should be assigned to a Normally Open relay so that it defaults to the active (open contact) state when power is removed from the controller.

Signals Off Confirm (LE)
This output signal indicates that the signals on the CPU pelican/pedestrian are off for whatever reason i.e. Signals switched off from the Manual Panel, Red Lamp Monitor failure, Conflict detected etc. This output signal should be assigned to a Normally Open relay so that it fails to the active (open contact) state.

Local Link Disable Confirm (LL)
This output signal indicate that the local link facility on the controller has been disabled, for whatever reason i.e. Local Link disable switch on Manual Panel active, UTC local link disable control bit active, timeswitch function etc.

UTC Bright Confirm (SOC)
This output signal indicates that the signals on the controller are in the bright state, for whatever reason i.e. daytime operation, dim override switch on Manual Panel active, UTC dim override control bit active etc.

Remote Reconnect (RR)
This reply bit is generated when the Remote Reconnect Switch on the Manual Panel is activated (indicated by the illumination of the associated LED). This switch indicates to the UTC central office that the controller is ready to resume under UTC control.

Real Time Clock Sync. Reply (CC)
This signal is made active if a successful RTC Sync. has occurred. The duration of the reply is 3 seconds.

Fall Back Confirm (FC)
An 'FC' bit may be returned to indicate that an 'FM' control bit has been received.

17.10.3 Local Link Facilities

Local Link Ped Inhibit (PV1)
While this signal is active, it prevents the appearance of the ped. phase irrespective of demands, subject to the effect of the Override timer described below. A delay time can be set via the handset so that there is this delay between the PV1 signal being released and the Inhibit on the controller being lifted. After this, a Window time which is also alterable via the handset, can come into effect. This is the time after the Inhibit has been lifted during which the controller ignores vehicle extension detectors and looks for a pedestrian demand to service, even if PV1 has been reapplied during this time. If the window timer expires and PV1 has not been reapplied the controller reverts to its normal working mode.

If PV1 is active the Override timer will start to time if it has been set to a non-zero value via the handset and normally at the start of the vehicle phase green. This override timer can optionally be selected (via the handset) to commence timing only if a pedestrian demand is present while the vehicle phase is at green. This timer is reset when the PV1 signal goes inactive. If it times out one of two actions may be taken, depending on handset selection:

(i) it will ignore the PV1 signal and revert to normal unlinked operation and only recognise the PV1 signal again if it is now released and re-applied.

(ii) it can operate in self resetting mode i.e. once the override timer expires it reloads itself, introduces the Link Delay and Link Window times and commences re-timing when either the Window time expires or the controller returns to vehicle green as a result of serving a Pedestrian demand during the Window period. If PV1 is released and reapplied normal linked operation resumes.

The Override timer is usually used only for MCE 0125 pelicans and its use is determined by checking for a non-zero timing value. There is another watchdog mechanism used for MCE 0145 pedestrian controllers which checks that the link is not permanently operated nor permanently released. This mechanism will be used if there is a non-zero timing value for the Link Failure Active/Inactive times. Timeout of either of these signifies "link failure" which causes the following actions:

Inhibit the appearance of the Pedestrian Phase.
Light the Wait Indicator
Light the Cabinet Alarm Lamp
Set a Fault Log Flag

After a "link failure", manual intervention is required to reset the fault log before the controller can resume normal operation.

In certain circumstances e.g. light traffic flow, the intersection controller will be unable to generate link inhibit release pulses often enough to prevent the timeout of a Fail timer and in these cases a pulse generator is required in the main controller to signify that the link is good. The pulse generator must ensure that the link inhibit is released and reapplied periodically to reset both the FAIL ACTIVE and FAIL INACTIVE link fail timers. To ensure that this pulse generator does not cause the link inhibit signal to be released erroneously certain timing restrictions are imposed on the pulses and signals:

$$20\text{ms} < \text{inhibit release pulse} \leq 300\text{ms}$$
$$\text{inhibit release signal} \geq 340\text{ms}$$

This means that if the signal on this line is released for less than 300ms and then reapplied the only effect will be to reset the Link Fail Active and Inactive timers. If the signal is released for more than 340ms and then reapplied, then the effect will be to reset the Link Fail Active and Inactive timers and to start the Link Delay timer.

Local Link Dim Request
This input signal is treated in the same manner as UTC Dim Override (DO) and is described in section 17.10.1.

Local Link Ped. Demand (LD)
This input signal puts in a remote pedestrian demand.

Link Out (Vehicle green confirm)
This output signal is essentially a Vehicle Green Confirm signal and can be used to provide a Ped. Inhibit (PV1) to another pelican usually in a staggered link situation. The effect then is to inhibit the ped. of the other pelican while it itself is not in the vehicle green period. Note that this does not take account of any race condition between two controllers that are linked together and as such if the pushbuttons of the two controllers are pressed simultaneously there is a possibility that both pelicans could go to green at the same time and so true dual pelican operation cannot be achieved in this manner.

Link Out (Dim Request)
This signal is used by the master controller in a linked dimming situation, where it is usually used to pass on the dim/bright state of the master to the slave pelican controller.

17.10.4 Call/Cancel Function

Call/Cancel Ped. Demand (CC)
This input signal acts as a normal call/cancel demand, in that a demand must be present for a certain period (call time) before the demand is accepted. Similarly if the demand disappears before the controller has satisfied it, then it must permanently disappear for a certain period (cancel time) before the controller will forget about it. The effect of the input is to put in a demand for the pedestrian phase, or for a turning phase. This facility can also be used on a detector input to provide the facilities of a queue detector.

17.10.5 Puffin I/O Facilities

More detail on the Puffin facility, refer to the General Puffin spec EM21843.

Push Button and Kerbside Detector Inputs
Two push button inputs are available on each Puffin stream. In addition, each Puffin stream has two kerbside detector inputs which indicate when there are pedestrians waiting to cross.

Each input from push button or kerbside detector is held active in the controller for a configurable hold time (after the input has gone inactive).

The pedestrian demand is only registered if the following conditions are met:

a) a push button is being pressed or hold period active
AND
b) a pedestrian is being detected by the kerbside detector or the kerbside hold period is active.

The pedestrian demand is cancelled and the wait indicator turned off if all kerbside detectors indicate no pedestrians present for a configured detector timeout period.

NOTE: Pedestrian demands from UTC or local link operate as on the Pelican controller i.e. the demand does not require the kerbside detector to be active in order to be registered and the demand is latched - not cleared when the kerbside timeout period expires.

Kerbside Detector Test Output

One test output is provided for each Puffin stream. This output should be wired to connect +24V through the 'normally open' relay contacts to the detector test input on surface mounted kerbside detectors.

While there is no pedestrian demand registered, each detector is tested at 10 second intervals. Note that the kerbside detector is tested during the pedestrian push button hold time, providing that no demand is registered.

The test output is driven with a 400mS pulse by the controller and a check is made for a detector response pulse. A missing or late response forces the detector active (within the controller) and an entry is made in the fault log. A subsequent correct response from the detector removes the force condition.

Detector testing is required with surface mounted detectors, but not with 'above ground' detectors. Detector testing is enabled by default. Testing can be disabled by de-allocating the corresponding detector test output.

NOTE: The test sequence results in a pulse appearing on the kerbside detector output. This will be treated as a normal pedestrian presence, activating the kerbside hold and timeout periods.

'On-crossing' Detector Inputs

Up to 4 inputs are available on each Puffin stream. The 'on-crossing' detector indicates when there are pedestrians moving on the crossing and is used to extend the variable clearance period on the move from pedestrian green to vehicle green.

Any configured 'on-crossing' detector remaining inactive during a cycle is assumed faulty and forces the following variable clearance period to be extended up to its maximum. An entry is also made in the fault log.

If the detector subsequently operates correctly, then the force is removed and normal operation resumed.

17.11 TIMESWITCH FACILITIES

17.11.1 Switch Audio off

This facility allows the pelican ped. audio signal to be turned off on a time of day basis. The Audio will only switch on/off during the vehicle green period.

17.11.2 Alternative Max. sets

This facility allows the four time sets that are available for each of the modes i.e. Pelican VA and FVP to be selectable on a time of day basis. To allow the UTC "Switch to Alternative times" signal (described in 17.10.1) some priority over the Timeset selection, the Timeswitch selection will only take effect when the UTC signal is not active.

17.11.3 Switch to FVP mode

This facility disables Pelican VA mode and thus introduces FVP mode on the pelican/pedestrian controller on a time of day basis.

17.11.4 Enhanced DFM

The later pelican configurations include the enhanced DFM facility, see section 15.9.1(15.9.1(b)).

17.12 CONDITIONING FACILITIES

17.12.1 Dual Level and Audible On/Off control.

Dual level audible operation is enabled via the handset. The changeover relay required for the switching is located on the first I/O expansion board. Switching between the two levels is achieved using the event timetable. Note that when using just the Loud audible indication this I/O line can be used to switch the audible output On/Off. See Figure 18.2.
When this facility is used no other signals can be allocated to Port 4.

On/Off control is effected as above or via the CPU output lines. The CPU line method must be used if no expansion board is fitted.

For a Pelican Controller the supply for the Audibles will come from the 2-Phase driver board.

17.12.2 Real Time Clock Synchronisation.

When enabled by the handset, two lines are dedicated - one to the Sync. input line and the other to a confirm line. See also UTC facilities information (Section 17.10.1).

17.12.3 Special Detector checking.

This facility is used in VA Mode. When enabled the Controller checks that during the Vehicle Green period the detector output changes state. If no change in state is detected then the All Red period is set to 3 Secs.

NOTE The use of these commands is fully explained in the T400 Controller Handset Command List. (See section on Pelican).

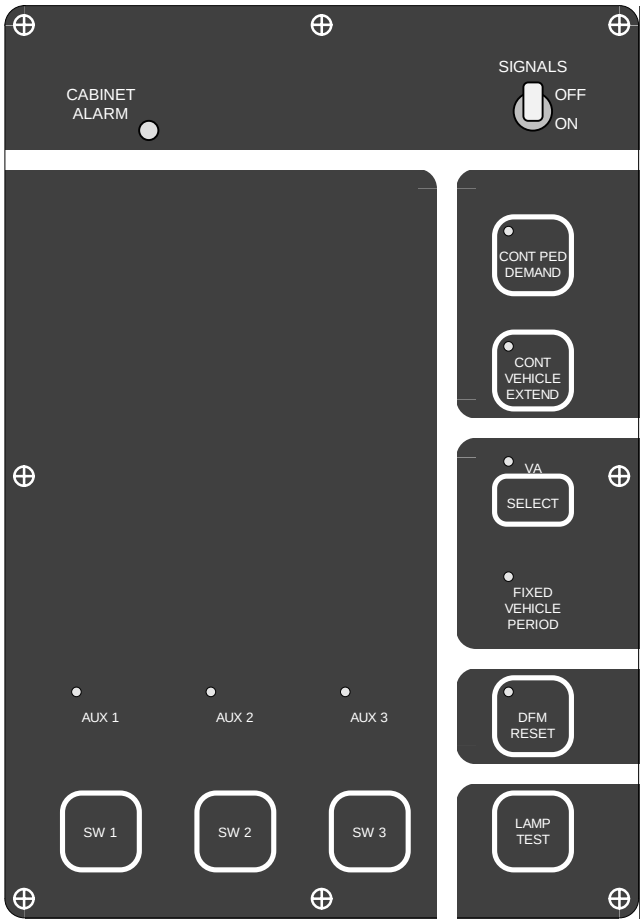
17.13 CLF FACILITIES

The only effect of CLF on a pelican controller is to provide a ped. inhibit signal. There is a corresponding group influence to cancel this ped inhibit influence i.e. an "Allow Ped" influence which is used to provide a ped window. This CLF inhibit signal inhibits the Pedestrian phase for as long as this input is active provided that there is an Allow Ped influence somewhere in the same group. If there is no Allow Ped influence within the same group then the CLF input has no effect.

17.14 CROSS INHIBIT LINKING (DUAL PELICAN)

To ensure that both pedestrian phases do not run green simultaneously enter the required handset command. For simultaneous demands stream 0 is the Master stream and stream 1 the slave. i.e. if simultaneous pedestrian demands are received the Master stream will run the Ped. phase but the slave stream will be inhibited until such time that the Traffic green on Stream 0 is re-established.

Figure 17.1 - Pelican Manual Panel (Standard)



and for a dual pelican...

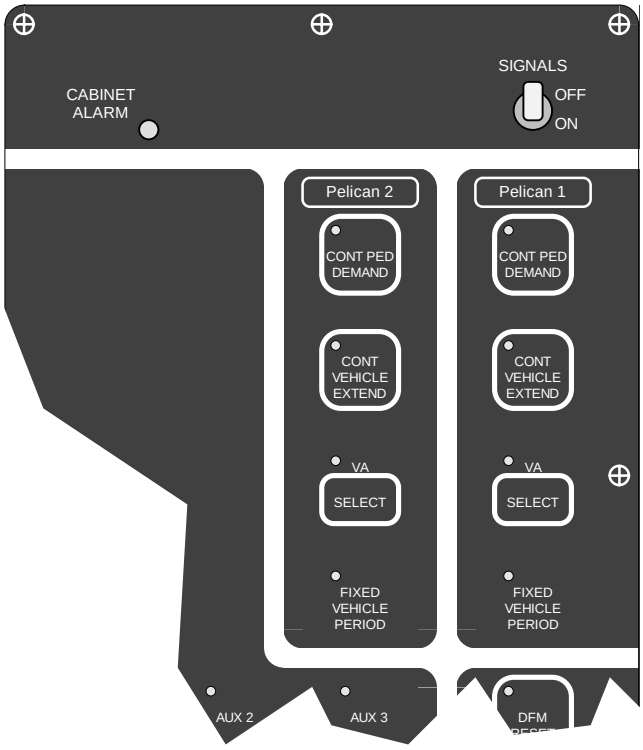


Figure 17.2 - Pelican Manual panel (Basic)

18. EQUIPMENT

18.1 PHASE FACILITIES

The Intersection Controller can drive up to 16 real phases. The Pelican can drive a traffic and a pedestrian phase. The signals are driven by 4-Phase Driver Boards on the Intersection Controller and 2-Phase Driver Boards on the Pelican. A 4-Phase Driver Board drives four 3-aspect phases and a 2-Phase Driver Board drives two 3-aspect phases with a MCE 0125/MCE 0145 Red Lamp Monitor circuit.

A real phase can control one of the following:

(i) vehicle movements via a 3-aspect signal
(ii) pedestrian movements via a 2-aspect signal and a WAIT indicator
(iii) vehicle movements via a green arrow signal.
(iv) a switched sign.

18.2 MAIN CONTROLLER UNITS

667/1/20200/000	Type 400 Controller (Large, small and options).
667/1/20240/000	Large Case Preliminary Assembly.
667/1/20240/100	Small Case Preliminary Assembly.
667/1/20284/001	Controller Manual Panel Assembly.
667/1/20284/002	Pelican Manual Panel Assembly.
667/1/20221/001	Main Processor PCB.(Intersection use.)
667/1/20221/002	Main Processor PCB.(Pelican use.)
667/1/20223/000	4 Phase Driver PCB
667/1/20225/000	2 Phase Driver + Red Lamp Monitor PCB.
667/1/20229/000	Expansion I/O PCB.
667/1/20231/000	SDE/SA PCB.

18.3 PED. AUDIBLE / TACTILE INDICATION (MCE0141 CONTROLLERS ONLY)

Items Required:

K-O-P for Signal Head mounted Audible/Tactile Drive 667/1/15799/000
K-O-P to add Audio Ind to Push Button Unit 667/1/01478/006

Note: If the dimmed supply voltage is 120V, 140V or 160V then the Sonalert Malary SC628P audible indicator can be used. Only at 160V dimming can the Bleeptone A.P. Bessom RS/1 18V be used.
It is recommended that all units are the same type on one supply.

The items are connected as shown in the circuit in Figure 18.1 to Figure 18.4. The connections to the transformer are via single to dual Faston terminals.

Note 1: It is a requirement of Department of Transport that audible signals may only be used if the pedestrian phase runs with no vehicle phases and it is accompanied by the Red Lamp Monitoring facility, see sections 19 and 25.

SWITCHED AUDIO/TACTILES
(DRIVE CIRCUIT MUST BE MOUNTED INSIDE THE CONTROLLER)

This facility provides the power unit to supply one group of three Audio/Tactile Indicators during Pedestrian Green time using a high current output. (This may be increased to twelve units if additional kits are added). The supply to the Audible/Tactile can be terminated before the end of the Pedestrian green by utilising a Controller output.

Note that the 'Radix System RS250' Tactile Unit is used if the Tactiles are to be switched since this provides an input for a steady DC voltage. Unswitched Tactiles can use the 'RS251' Tactile Unit. The 'RS252' Tactile Unit can be used in either situations and is 'configured' by the use of a link.

Note that the Pedestrian advice note specifies that irrespective of whether the pedestrian signal is for sighted or unsighted people, the intergreen given should be the same. If however the intergreen time for sighted people is reduced below the specified time and the Tactile HAS to be terminated early to provide safety to the unsighted people the above method must not be used. A separate phase with its own intergreen must be used to drive an intersection Tactile.

18.4 SWITCHED MAINS VOLTAGE PEDESTRIAN AUDIBLES (Export Only)

In certain export markets (presently Hong Kong) the Pedestrian audible units are powered from mains voltage namely the pedestrian phase green man supply and red man supply. When connected to the green and red man supplies the audio units give high rate audible clicks as a signal during the green man and lower rate audible clicks as a signal during the red man. The supplies to these units may be taken via relay contacts to allow the audio to be switched off at a certain time of day. The required kit for the switching of these audio units is:

Audio Switching Kit of Parts 667/1/21470/000

18.5 DUAL LEVEL AUDIBLES

Items Required:

Kit Of Parts to add secondary buzzer.....667/1/15292/000

The audible indication can be Dual Level, this is achieved in the same way as for the Pelican. See Section 17.12 and Figure 18.8.

The audibles will only change state during the vehicle green period.

Output Bits controlling the change over relay, the On/Off relay and terminal block connections are specified in the Works Specification.
The change over relay is situated on the I/O Expansion board. If an additional On/Off Relay is also required this is available on the micro-processor board.

NOTE: If the additional On/Off Relay is also connected in series with the Dual Level Audible change over contact then only two audibles units may be connected to the drive.

18.6 DETECTOR RACKS AND DETECTORS

A number of detectors and their associated racks can be fitted into the T400 racking system.

The units available are as follows:

Racks

667/7/17017/001	19 inch detector rack
667/7/17017/000	11 inch detector rack
667/1/15990/002	Dual detector backplane kit
667/1/15990/003	Single detector backplane kit
667/1/15900/004	U/D, Count and Queue backplane kit
667/1/20359/002	Siemens (ST) self tune detectors or Microsense ST detectors short rack with backplane for two detector cards.
667/1/15180/***	Sarasota AT45Z detector rack equipped with Detector card and detectors. Variant number relates to number of detectors required.
654/4/01028/***	Sarasota AT25Z detector rack with detector cards (various numbers of backplanes). Variant number relates to number of detectors that rack is equipped for.

Detectors

Siemens (ST) Self Tune Detectors MkII	667/1/17180/012 = 2 detector channel unit 667/1/17180/014 = 4 detector channel unit
Microsense (ST) Self Tune Detectors (Type MSE)	667/7/20360/002 = 2 detector channel unit 667/7/20360/004 = 4 detector channel unit
Sarasota AT25Z	654/4/01027/000 = 1 detector channel unit
Sarasota MCE25Z	Single Detector Channel Unit
26Z	2 Detector Channel Unit
28Z	4 Detector Channel Unit
Sarasota MTS35Z	Single Detector Channel Unit
36Z	2 Detector Channel Unit
38Z	4 Detector Channel Unit

18.7 SIGNAL DIMMING

Signal dimming is provided to dim the signals during darkness hours under control of a photo-electric cell mounted on a signal head.

There are three values of dimming voltage available:

- 120V
- 140V
- 160V (preferred value)

The type of dimming transformer required depends on the value of the dimming voltage and the total average power load on the controller. For selection of the Dimming Transformer see the General Handbook 667/HB/20200/000.

Figure 21.1 indicates where to specify the dimming voltage required.

18.7.1 Dimming by Time of Day

The dimming facility may be operated by time of day rather than a light operated switch (Solar Cell). To allow this facility to be implemented, the Solar Cell input of the controller must be wired to mains supply voltage to switch the controller to 'DIM' permanently. This state is then 'overridden' by special conditioning to switch the controller to the Bright State.

Normally, the time of dim state change is 'hard coded' into the special conditioning (using the special conditioning compare facility to compare the RTC to a fixed value). Although this means that if the time of the dim state change needs to be changed, the controller will need to be re-configured, the advantage is that changing the MTC timetable will not alter the dimming facility.

Alternatively, a special conditioning flag can be set from the MTC timetable to indicate when to switch to bright, allowing the time of dim state change to be altered by changing the timetable using the handset. However, care must be taken when changing any timetable times/functions via the handset, to ensure that the dim state change time has not altered. In addition, this alternative uses up the 'Parameter Table' rapidly if functions/switches need to be active in both states, i.e. dim and bright. This is because in this situation two parameters would be required both identical except for the special conditioning flag controlling the dimming. The flag would be set in one parameter and not set in the other.

18.8 T400 FAILURE FLASHER UNIT

The Hardware Failure Flasher can flash up to 16 individual aspects, the basic assembly catering for 4 aspects. Additional kits catering for further groups of four aspects may be added to provide switching for up to 16 phases.

The On/Off periods are variable on the Fail Flasher from 0 to 1260 mS (1.26 Secs.) in 20mS steps. Flasher periods should not be set below 240mS for either the On or Off periods.

18.9 FUSES, LOADING, VOLTAGE AND FREQUENCY

This information is covered in the General Handbook, 667/HB/20200/000 Section 2.

18.10 CONTROLLER DOOR STAY FACILITIES

Two alternatives exist:-

Kit Of Parts for Door Stay.....667/1/21478/000
Kit Of Parts for Door Stop (Maintenance) 667/1/21480/000

The large doors may each be fitted with a door stay which automatically locks the door when opened at an angle of approximately 90 degrees. Lifting the stay bar allows the doors to be closed. The door stay facility can be disabled simply if not required. Although normally a factory fitted facility it is possible to implement it in the Field.

Alternatively, for maintenance purposes, a Door Stop can be fitted.

18.11 INTERNAL ILLUMINATION

Used on single sided access only. Bulkhead type lamp operated by door activated microswitch.

18.12 POWERING EXTERNALLY SITUATED D-DETECTORS WITH PSU TYPE 667/1/20654/000

Items Required:

Kit Of Parts required 667/1/20659/000

This is an unregulated nominal 45 volt PSU option which may be retrofitted to a Siemens T400L or T400S Traffic Controller to provide a DC supply for the old Type D inductive loop detectors fitted in external housings ("beehives").

This unit is a simple transformer isolated, capacitor-smoothed supply designed to fit into a Type 400 controller. It consists of a single metal plate to which the electronic items are fitted and interconnected by hand wiring.

Each beehive is equipped with a Regulator in addition to a number of detector cards.

Load Calculation

Maximum O/P current = 500 milliamps
Current per Regulator board = 16 milliamps (1 regulator per beehive)
Current per detector board = 48 milliamps

Figure 18.1 - PEDESTRIAN AUDIBLE INDICATION (SIGNAL HEAD MOUNTING)

(Note: If it is required to switch the Audibles, then see Figure 18.2)

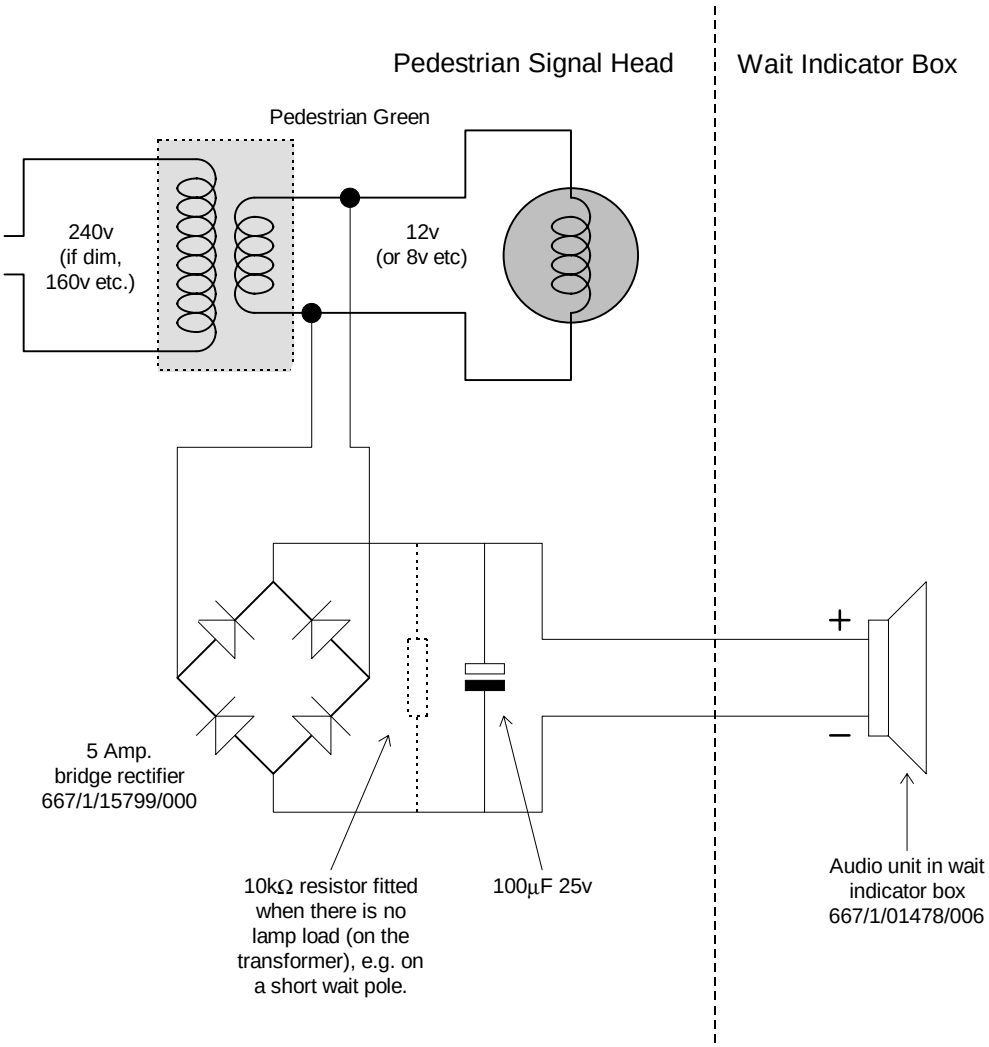


Figure 18.2 - PEDESTRIAN AUDIBLE INDICATION (CONTROLLER MOUNTING)

(Note: If it is not required to switch the Audibles, then they may be driven from the signal head transformer itself, see Figure 18.1)

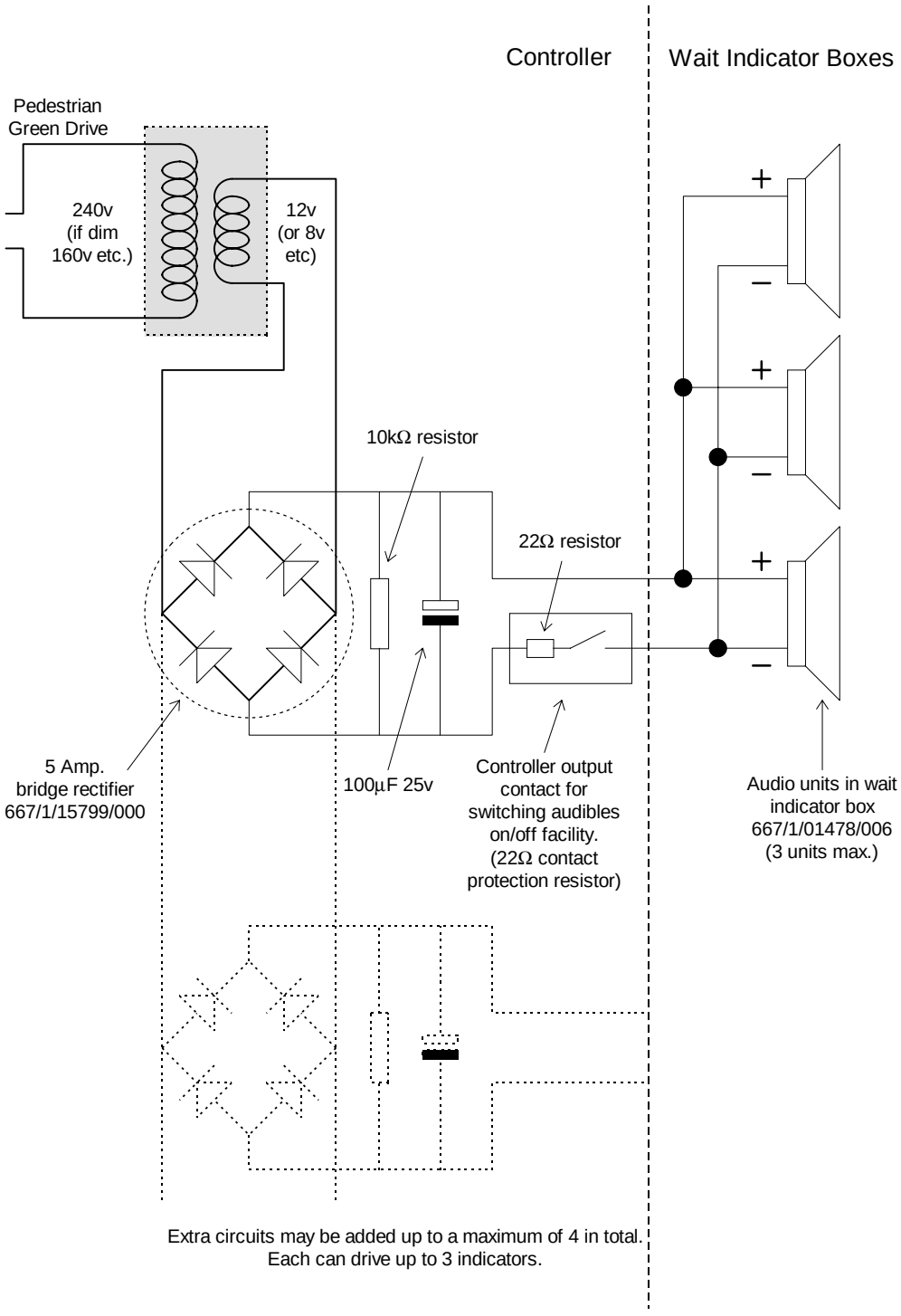

Controller
Wait Indicator Boxes
Pedestrian Green Drive
240v (if dim 160v etc.)
12v (or 8v etc)
10kΩ resistor
22Ω resistor
5 Amp. bridge rectifier 667/1/15799/000
100µF 25v
Controller output contact for switching audibles on/off facility. (22Ω contact protection resistor)
Audio units in wait indicator box 667/1/01478/006 (3 units max.)
Extra circuits may be added up to a maximum of 4 in total. Each can drive up to 3 indicators.

Figure 18.3 - PEDESTRIAN TACTILE INDICATION (SIGNAL HEAD MOUNTING)

(Note: If it is required to switch the Tactile, see Figure 18.4)

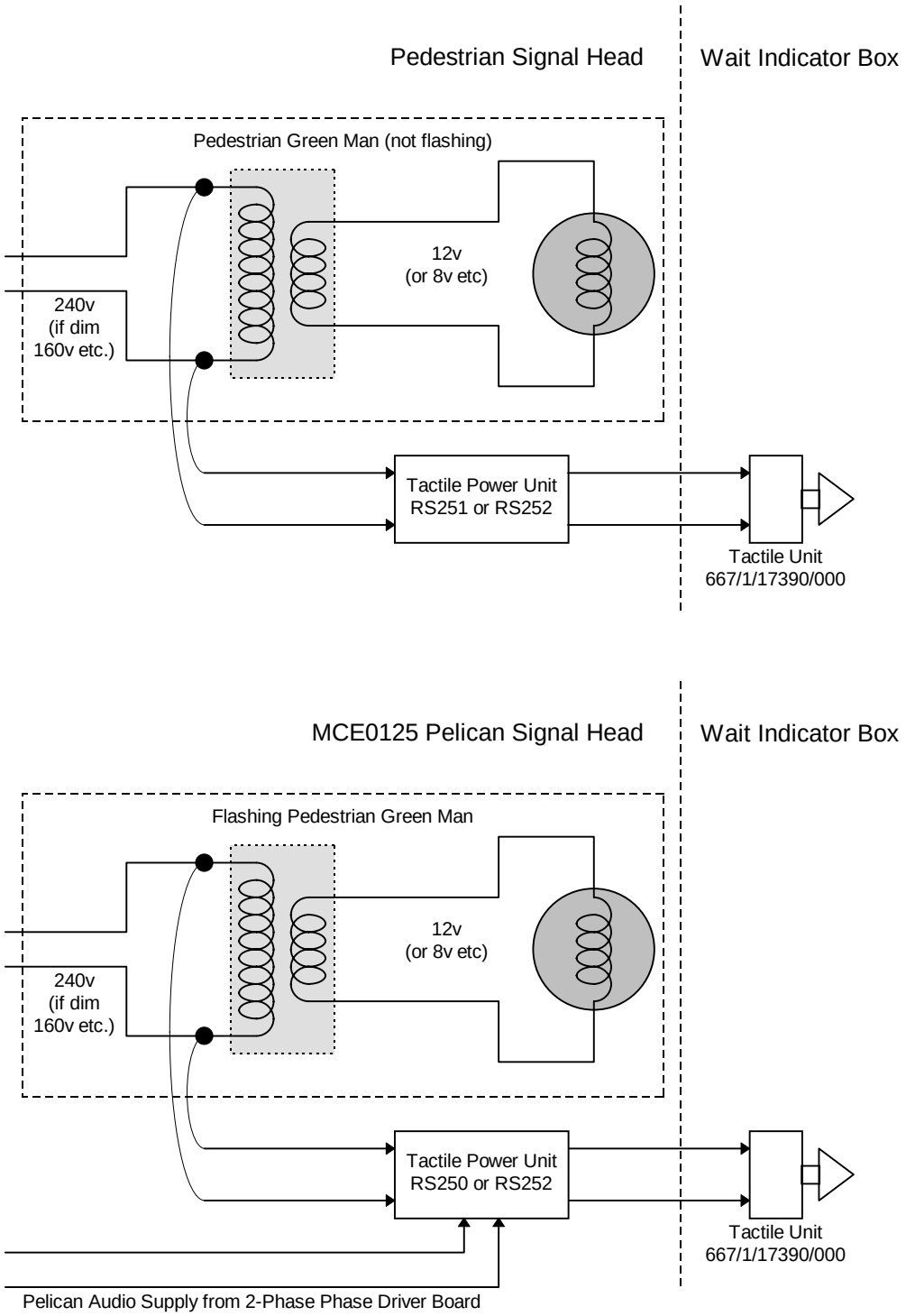


Figure 18.4 - PEDESTRIAN TACTILE INDICATION (CONTROLLER MOUNTING)

(Note: If it is not required to switch the tactiles, then see Figure 18.3)

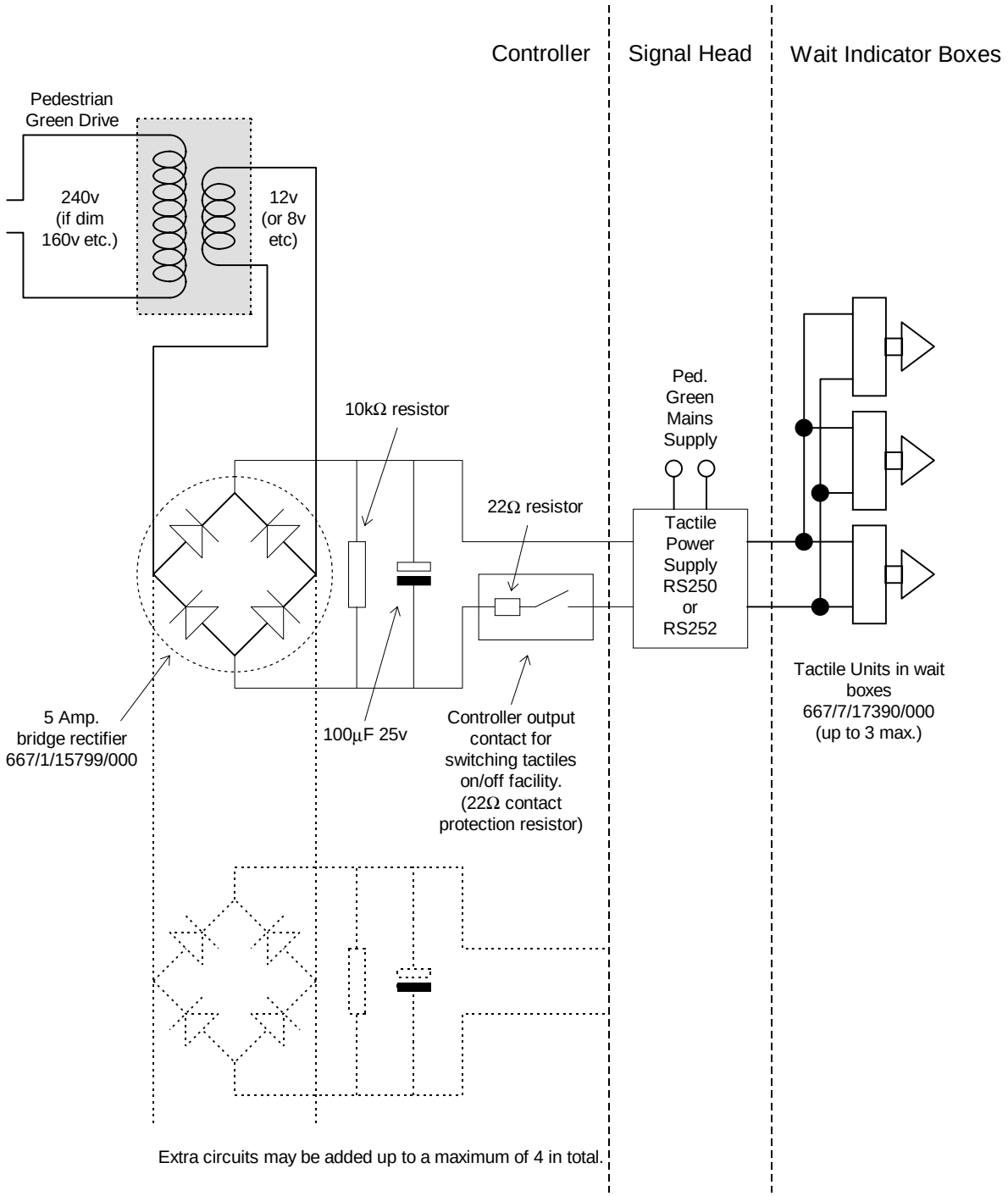
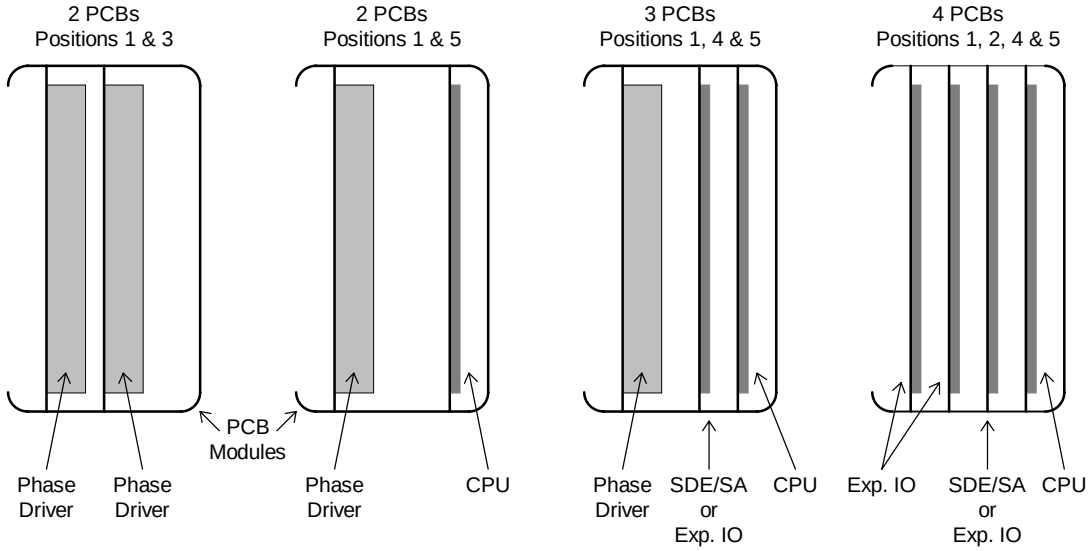
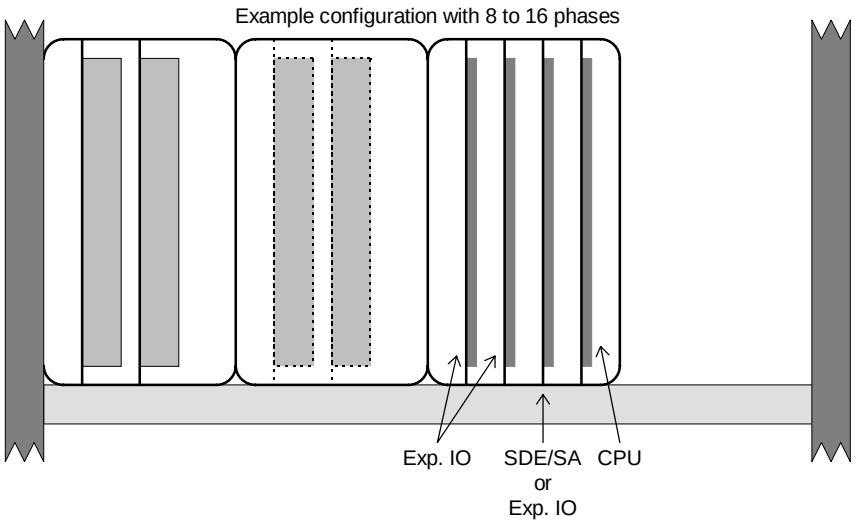


Figure 18.5 - POSSIBLE PCB CONFIGURATIONS





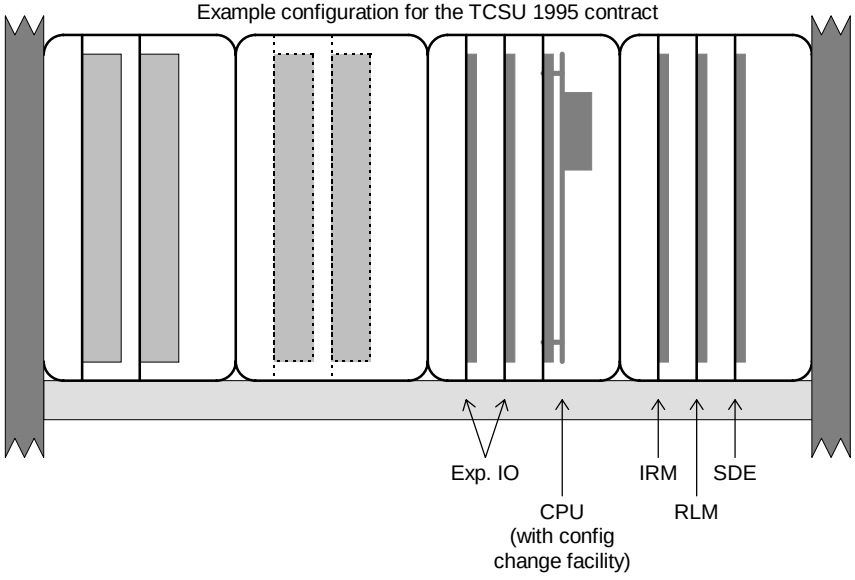


Figure 18.6 - FRONT VIEW OF THE TYPE 400 CONTROLLER (LARGE O/C)

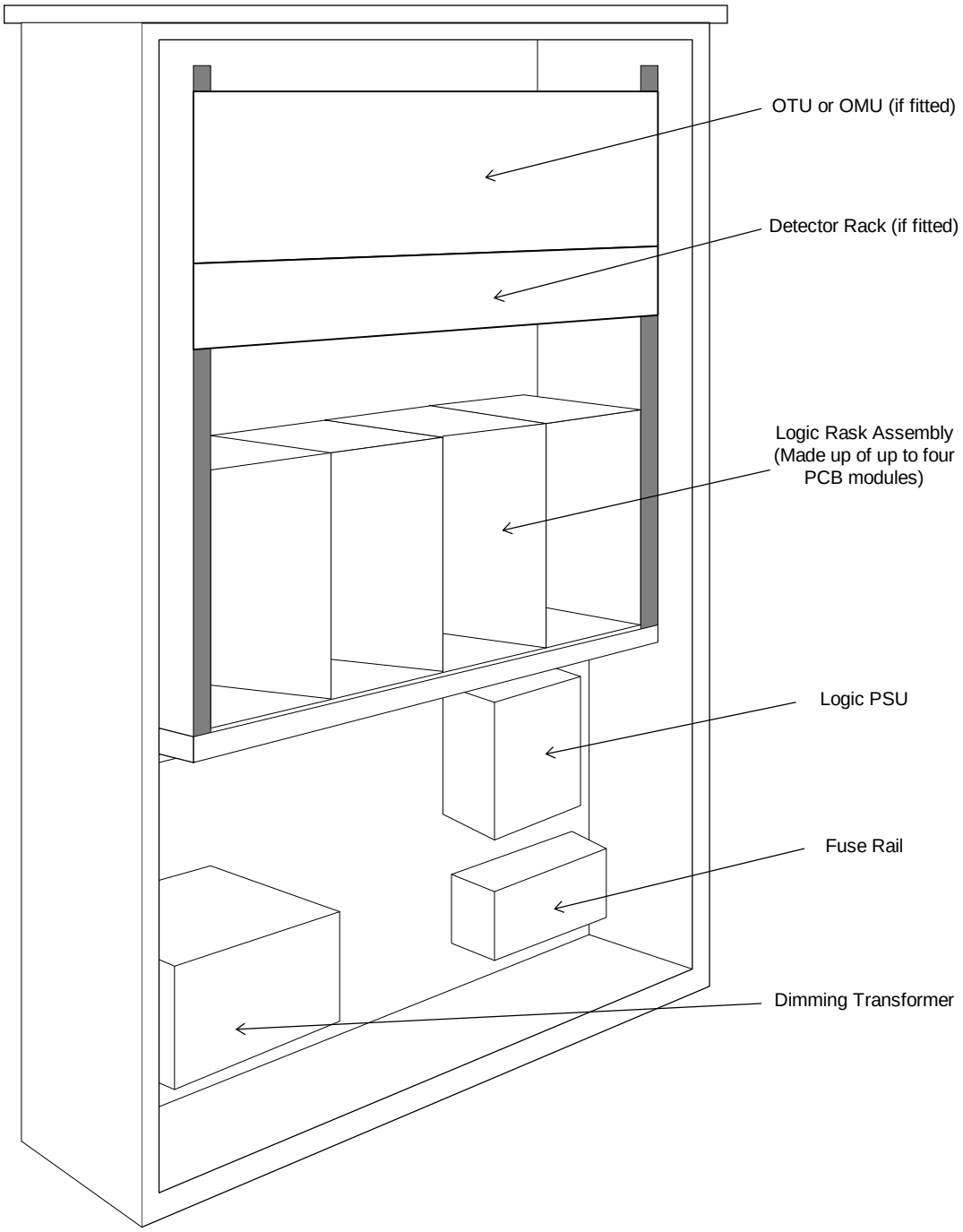
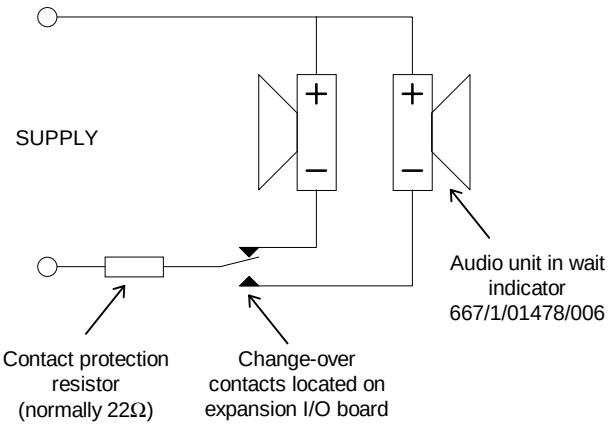


Figure 18.7 - FRONT VIEW OF THE TYPE 400 CONTROLLER (SMALL O/C)

(see Figure 15.4 - TERMINAL BLOCKS IN SMALL CONTROLLER on page 15-8)

Figure 18.8 - CONNECTING DUAL LEVEL AUDIBLES


SUPPLY
Audio unit in wait indicator 667/1/01478/006
Contact protection resistor (normally 22Ω)
Change-over contacts located on expansion I/O board

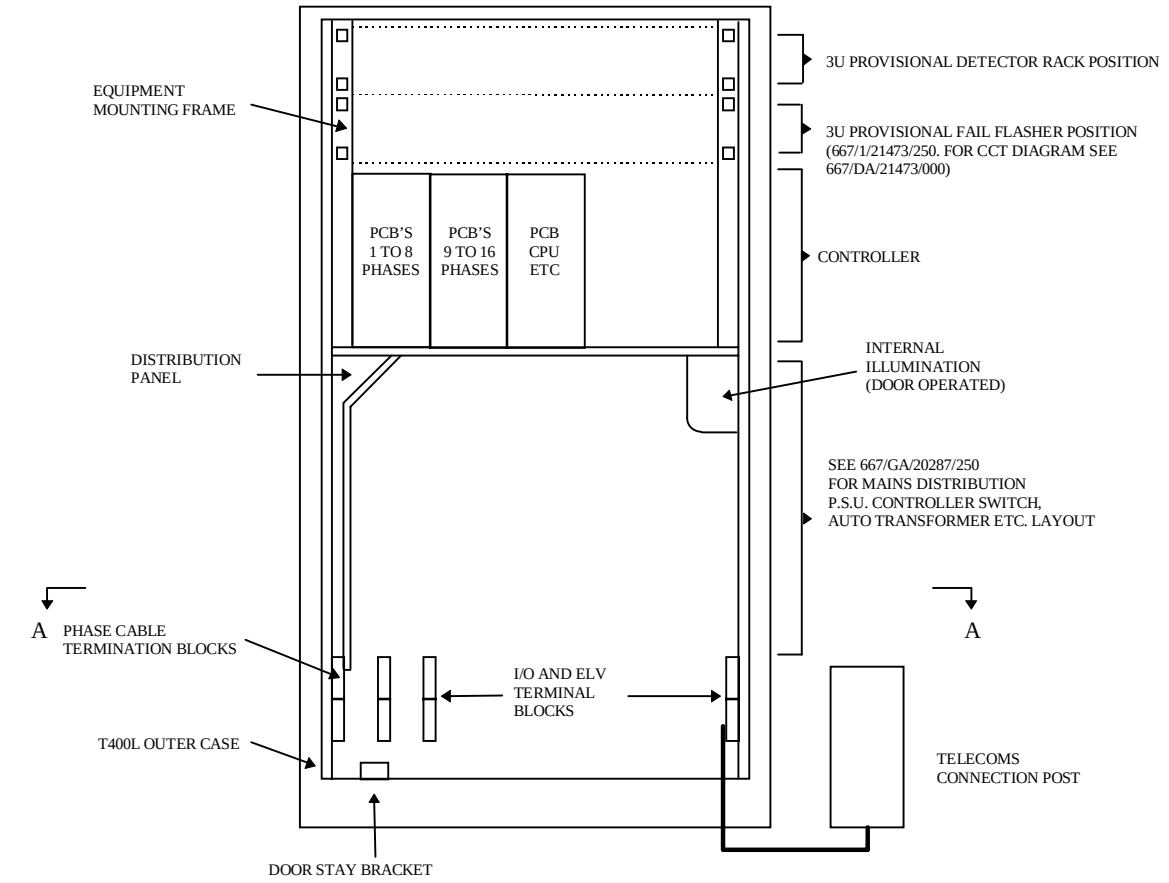
Notes:-

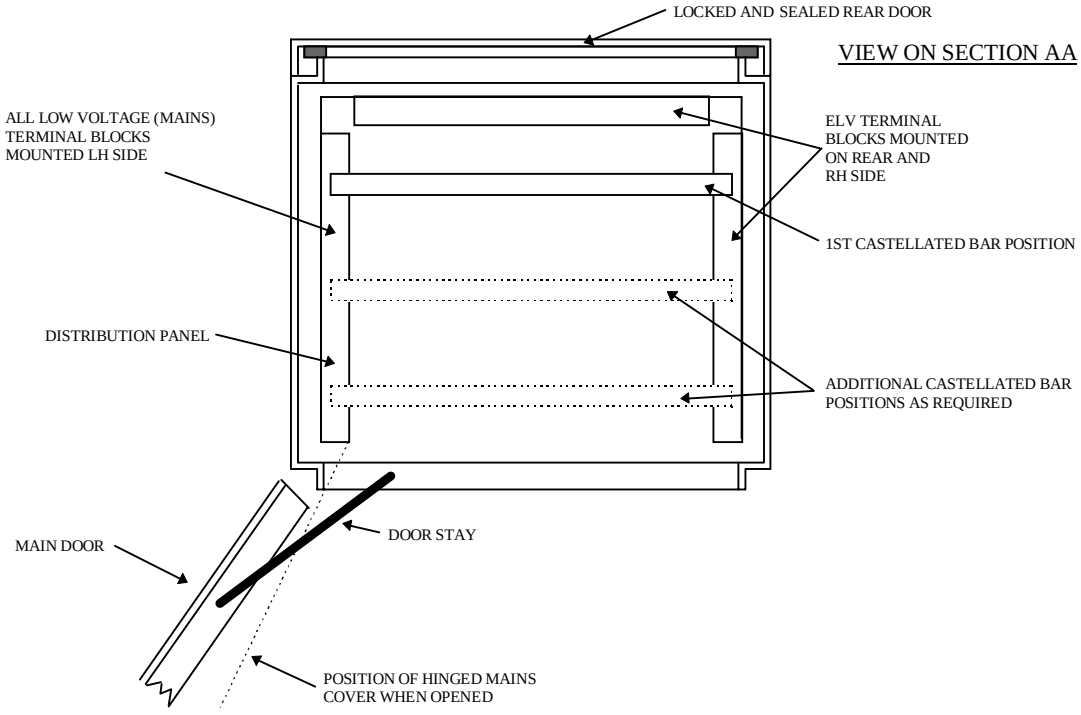
(i) On an intersection controller, the supply for the audibles would originate from a transformer mounted in the controller as shown in Figure 18.2.

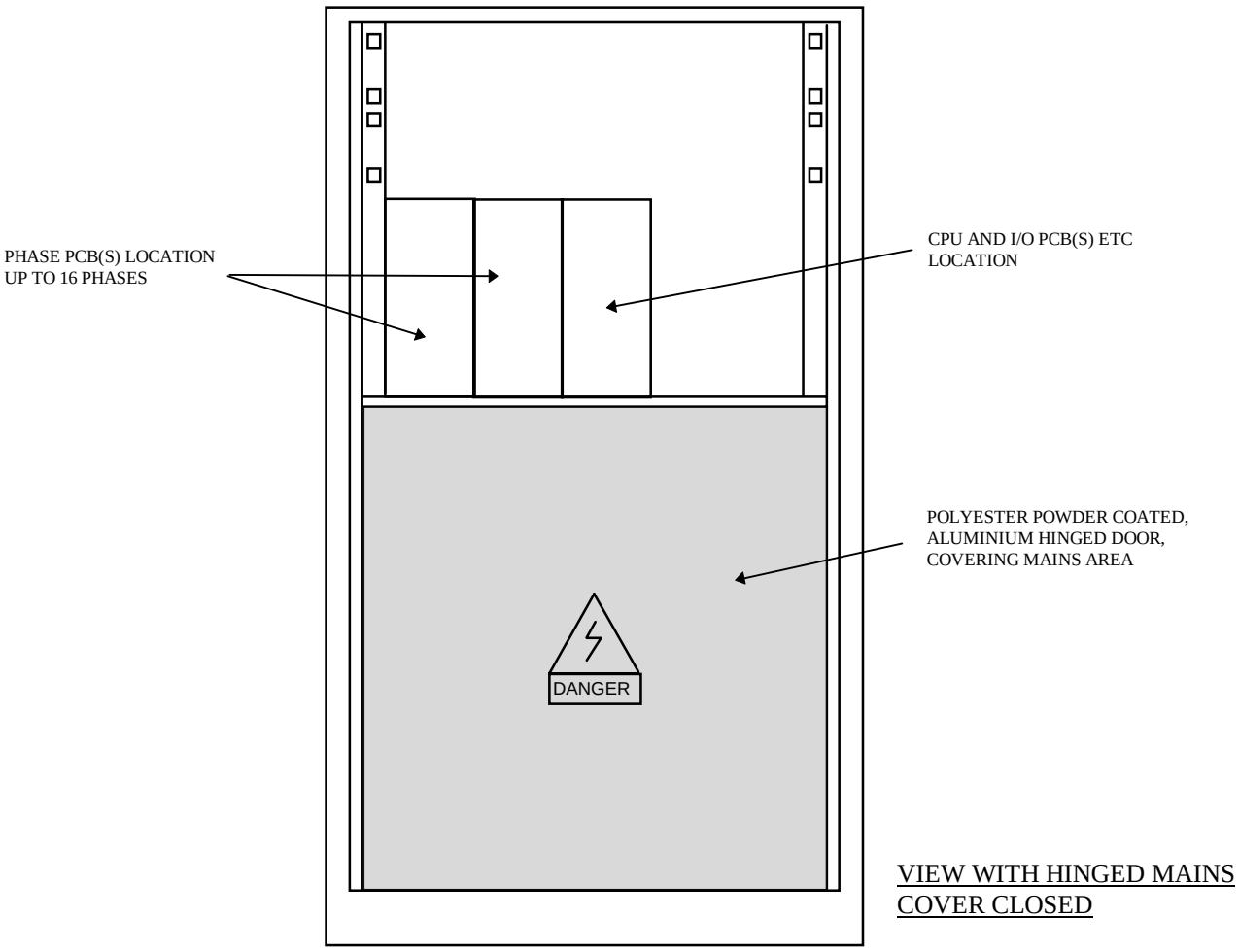
(ii) For a pelican controller, the supply will come from the 2-phase driver board.

(iii) Note that the high current outputs are used, i.e. the contacts are protected by a series resistor of 22Ω.

Figure 18.9 - Single Sided Access T400L


EQUIPMENT MOUNTING FRAME
3U PROVISIONAL DETECTOR RACK POSITION
3U PROVISIONAL FAIL FLASHER POSITION (667/1/21473/250. FOR CCT DIAGRAM SEE 667/DA/21473/000)
PCB'S 1 TO 8 PHASES
PCB'S 9 TO 16 PHASES
PCB CPU ETC
CONTROLLER
DISTRIBUTION PANEL
INTERNAL ILLUMINATION (DOOR OPERATED)
SEE 667/GA/20287/250 FOR MAINS DISTRIBUTION P.S.U. CONTROLLER SWITCH, AUTO TRANSFORMER ETC. LAYOUT
A
A
PHASE CABLE TERMINATION BLOCKS
I/O AND ELV TERMINAL BLOCKS
T400L OUTER CASE
TELECOMS CONNECTION POST
DOOR STAY BRACKET


LOCKED AND SEALED REAR DOOR
VIEW ON SECTION AA
ALL LOW VOLTAGE (MAINS) TERMINAL BLOCKS MOUNTED LH SIDE
ELV TERMINAL BLOCKS MOUNTED ON REAR AND RH SIDE
1ST CASTELLATED BAR POSITION
DISTRIBUTION PANEL
ADDITIONAL CASTELLATED BAR POSITIONS AS REQUIRED
DOOR STAY
MAIN DOOR
POSITION OF HINGED MAINS COVER WHEN OPENED



VIEW WITH HINGED MAINS COVER CLOSED

19. ORIGINAL LAMP MONITORING UNIT

This is a separate item of hardware and is not part of the controller. It should not be mistaken for the 'integral' Red Lamp Monitor facility on the 'ancillary processor card', see section 25.

The Lamp Monitoring Unit provides a means to check that the signals at an intersection are in the required state and no failures have occurred. Very little pre-installation configuration is required as the LMU has the ability to "learn" the intersection and report any lamp failures.

There are six types of controller outputs that can be monitored.

1) Wait indicators, single green arrows and secret signs

2) Pedestrian (2 aspect)

3) Vehicle (3 aspect)

4) Regulatory signs (only during bright state of controller)

5) Pelican - vehicle (3 aspect)

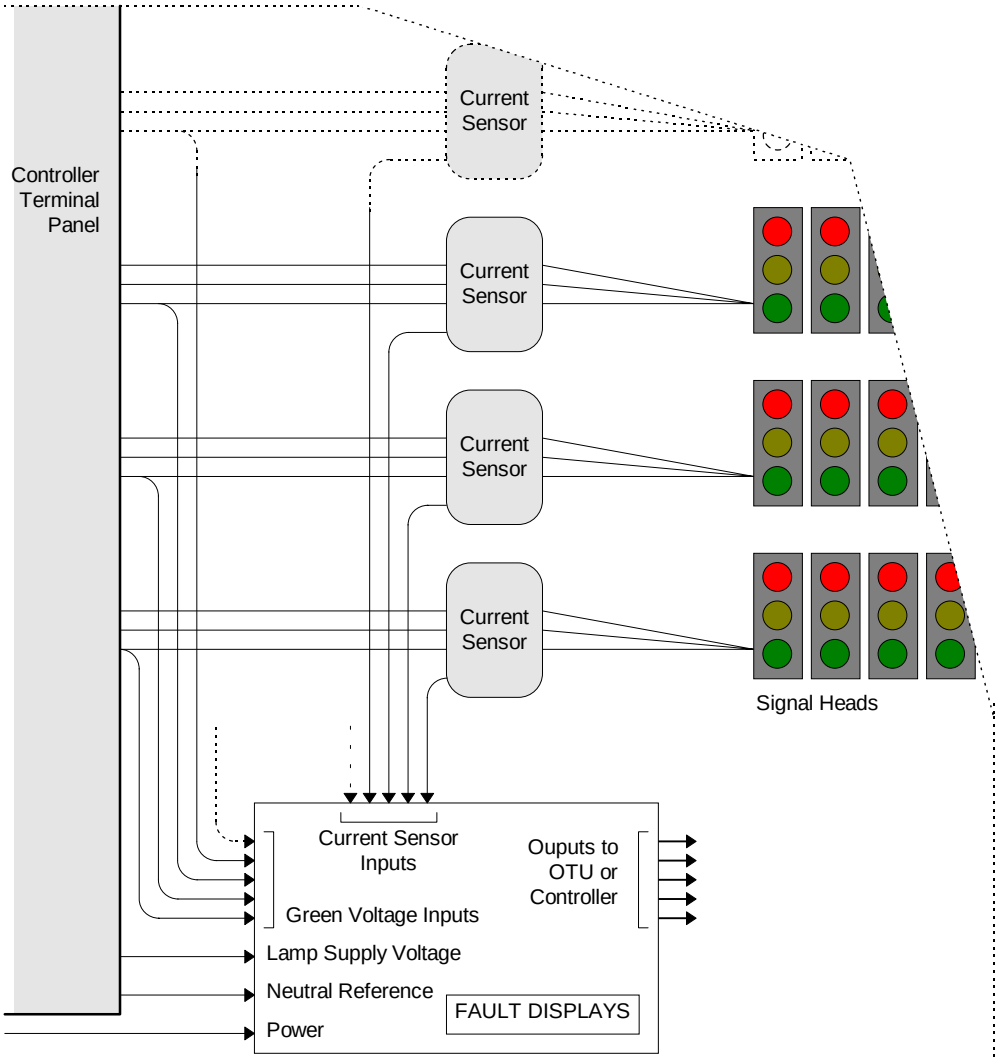
6) Pelican - pedestrian (2 aspect)

A single LMU is capable of monitoring up to 15 controller outputs.

Each output from the controller that is monitored provides information about the current flowing, status of the green signal for that output and value of mains voltage. The inputs are monitored by the software at a rate of 1 per mains cycle, this checks if the status is correct and determines if any lamps have failed.

Fault information is sent out through outputs which are connected directly to the OTU with standard lamp monitoring or via the controller with red lamp monitoring.

Figure 19.1 - LAMP MONITOR OVERVIEW



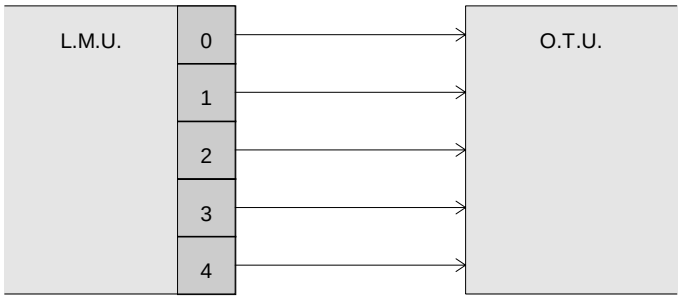
19.1 LAMP MONITOR + OTU (NOT RED LAMP MONITORING)

With the standard lamp monitoring, 5 outputs can be used from the LMU which are activated as follows:

Fault Output 0	-	Red lamp failure on any 3 aspect vehicle phase
Fault Output 1	-	Activated if a second red lamp fails on any 3 aspect vehicle phase where a red lamp has previously failed
Fault Output 2	-	Any one lamp (red, amber, green, regulatory sign or wait indicator) on an input being monitored fails
Fault Output 3	-	Active if a second red lamp failure is pending on any 3 aspect vehicle phase where a red lamp has already failed
Fault Output 4	-	Activated if a green lamp on any 3 aspect vehicle phase has failed
Fault Outputs Set During Lamps Off	-	Fault Output 2 Fault Output 3 Fault Output 4

These LMU outputs connected directly to OTU to give required reply bits when LMU outputs are activated.

These outputs have no effect on controller operation.



19.2 RED LAMP MONITORING

This facility monitors the state of lamps at an intersection as in standard lamp monitoring. There are 3 outputs from RLMU that affect the controller operation with another 2 outputs which can be connected directly to the OTU.

RLMU Output	Cause Of Output	Controller Input Ref.	MCK 1061 Reference
0	Activated if a red lamp fails on any 3 aspect vehicle phase	LMU1	Indication 1
1	Activated if a second red lamp fails on any 3 aspect vehicle phase where a red lamp has previously failed	LMU2	Indication 2
2	Activated if a second red lamp failure is pending on any 3 aspect vehicle phase where a red lamp has already failed	LMU3	Indication 3
3	Active if any one lamp (red, amber, green, reg. sign, or wait indicator) on an input being monitored fails	-	Connect directly to **OTU** if required
4	Active if any green lamp on any 3 aspect vehicle phase has failed	-	Connect directly to **OTU** if required

(Fault Outputs Set During Lamps Off - Fault Outputs 3 and 4)

Red Lamp Monitoring is used on part-time signals or intersections with pedestrian phases with audible or tactile indicators and pedestrian only stage.

The Red Lamp Monitor outputs 0, 1 and 2 are connected into the T400 controller with outputs 3 and 4 connected directly into the OTU.

Each of the outputs from the LMU can only be connected to one input on the controller so if a UTC reply bit is required when either fault output 0, 1 or 2 goes active, it must be achieved via conditioning.

The 3 controller inputs (LMU1, LMU2 and LMU3) have relay contacts open when active. In the event of LMU fail or incorrect connections the controllers sees all 3 inputs as being active. This causes controller to respond accordingly.

NOTES

(1) CLF Mode - When calculating the minimum cycle time of a CLF plan the Red extensions due to Red Lamp Monitoring should be included with the Intergreen and Minimum running times. CLF plans must have a cycle time greater than the calculated minimum otherwise synchronism may be lost.

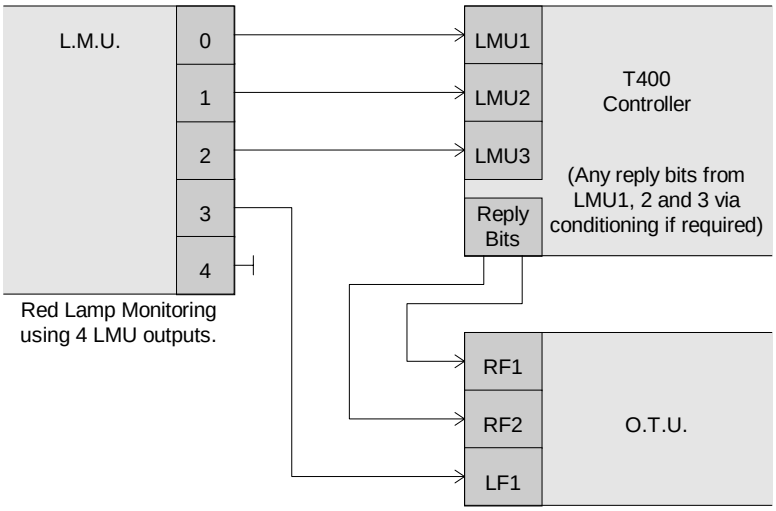
(2) UTC Mode - RF1 and RF2 UTC reply bits should be configured from LMU1 and LMU2 signals respectively to allow the Instation to recognise that a compliance error could be due to a Red Lamp Monitor extension.

(3) Fixed Time Mode - The cycle time may be increased during Red Lamp Monitor extensions.

(4) A single red lamp monitor unit is usually used for single or parallel stage stream controllers.
On parallel stage streaming controllers a single red lamp failure will introduce the appropriate intergreen extensions on all streams. If two red lamp failures are detected on a particular vehicle phase all pedestrian phases on all streams will be inhibited.

Multiple LMUs may be used to monitor each stream separately, this will introduce appropriate intergreen extensions and inhibit phases on that particular stream only. As this requires significant additional hardware (LMU, Mounting kits etc.) and the red lamp monitoring facility to be implemented in special conditioning, THE USE OF MULTIPLE LMUs IS NOT RECOMMENDED.

Figure 19.2 - RED LAMP MONITORING



a) Red Lamp Monitoring on Part-Time Signals

The LMU outputs have the following effects on the controller when they become active.

Indication 1: The cabinet alarm lamp flashes which overrides a requirement for it to be continuously illuminated. The all red period of intergreens will be extended up to 3 seconds. This extension will not be apparent if the all-red period during the normal intergreen is equal to or greater than 3 Secs.

Indication 3: The all red period for the intergreens will be extended up to 8 seconds for any Vehicle to Ped. transition.

Indication 2: Within 500ms of this signal becoming active the signals extinguish and will not switch on until Indication 2 becomes inactive.

b) Lamp Monitoring with Audible / Tactile Indicators

Note that the Pedestrian stage must be exclusive of any Traffic Phases if Audibles are used.

When these indications are active they have the following effects on the controller.

Indication 1: The cabinet alarm lamp flashes which overrides a requirement for it to be continuously illuminated. The all red period of intergreens will be extended up to 3 seconds. This extension will not be apparent if the all-red period during the normal intergreen is equal to or greater than 3 Secs.

Indication 3: The all red period of intergreens is further extended by a period of 8 seconds for any Vehicle to Ped. transition.

Indication 2: **When Indication 2 becomes active the controller may be in one of several states i.e.:**

Case 1 - Controller running a stage other than that which contains the Ped. with Audible / Tactiles:-

The Pedestrian phase will not appear.

Case 2 - Controller running stage in which the Ped. with Audibles / Tactiles is run:-

The Controller will force VA mode, lift any extensions to ensure that the Stage is run for only a minimum time. On leaving and re-entering the stage the Pedestrian phase will not appear.

Case 3 - Controller making transition to the Stage which contains the Ped. with Audibles / Tactiles:-

The Stage will appear without the Ped. phase (All Red will show if the stage is an exclusive Ped. Stage). On entering this stage Case 2 will apply.

Following the above cases the pedestrian demands are inhibited and wait indicators illuminated. The pedestrian phase will stay at red until the fault has been rectified and Indication 2 becomes inactive. i.e. the Pedestrian Stage will not appear.

For Indications 1 and 3 above, the LMU will extend the configured intergreens to the relevant all red periods even if an all red extension is operating from the normal Extend All Red facility. However, if the LMU causes an all red extension on a configured stage change then the normal Extend All Red facility cannot then subsequently introduce an additional extension during this all red period. (See also subsection 2.6.6 and 2.6.8).

19.2.1 Effect of RLM on Intergreens and Phase delays

When a red fail is indicated by the RLMU, subsequent stage to stage moves are affected as described below.

A hold timer is started at the start of the interstage period, i.e. at the start of the amber leaving or losing delay period as appropriate.
The hold timer has no effect on controller operation until a phase in the next stage is about to go to red/amber and then all the intergreen and gaining delay timers are suspended. The suspension is lifted when the configured hold time expires and then the intergreen and gaining delay timers resume timing off the remainder of their periods.

Where losing delays are configured on a stage to stage movement, the hold timer is increased by the longest losing delay on that move. Thus the required red period is given even when the losing delays are changed.

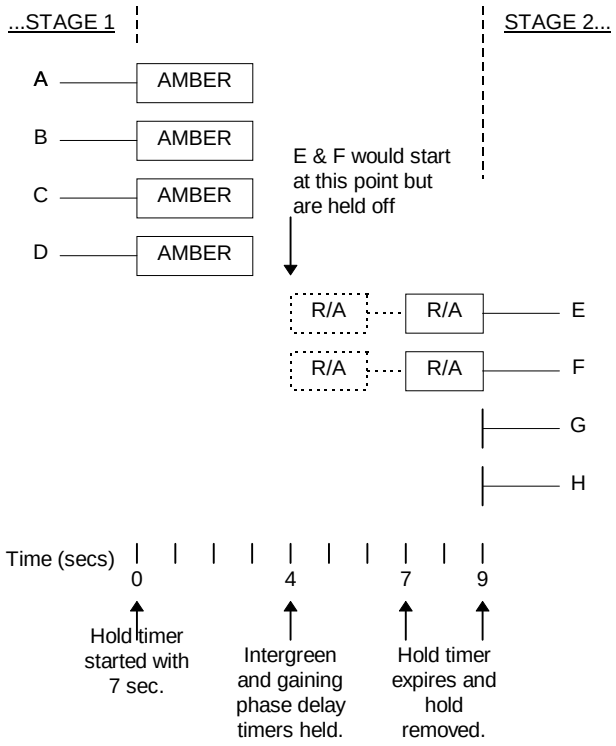
NOTE To ensure a 5 sec. red period, the hold time should be configured as 8 sec. to allow for the 3 sec amber period.

If the intergreens are long, the hold timer will expire before the phase intergreens and no additional clearance will be given.

The gaining delay timers and intergreen timers are all held to ensure that the offsets between gaining phases are maintained.

See also Figure 19.3 and Figure 19.4.

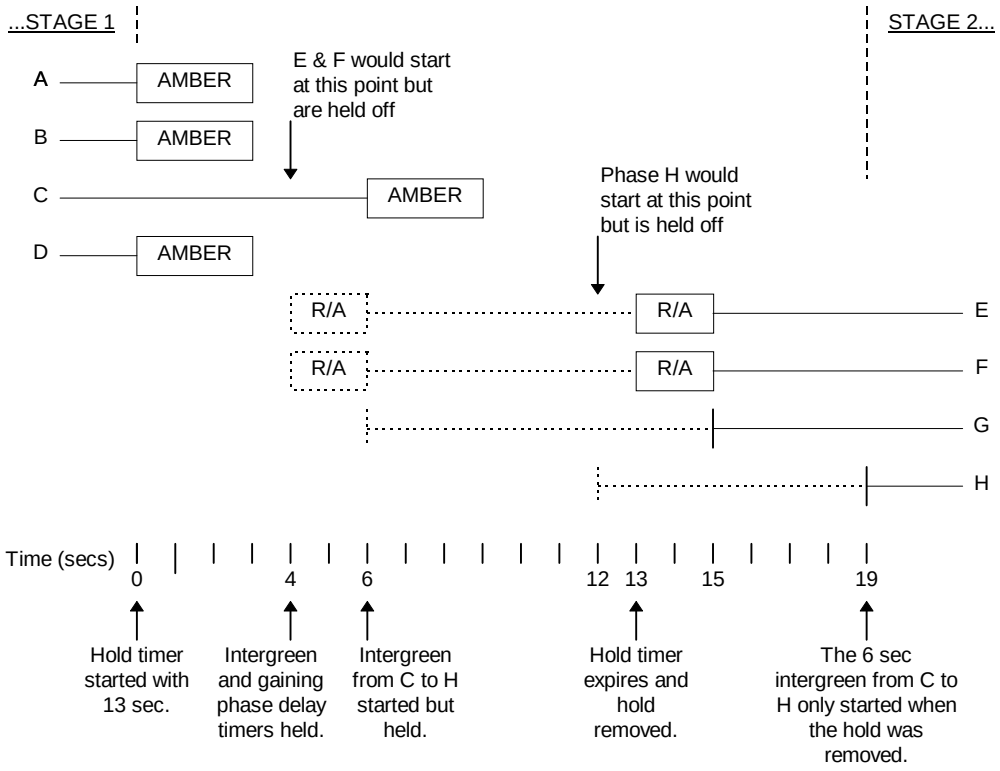
Figure 19.3 - LMU Hold without losing phase delay



Notes:-

(i) All intergreens are set to 6 seconds.
(ii) Hold time (SIE) set to 7 seconds.
(iii) 1st RLM fail active.

Figure 19.4 - LMU Hold with losing phase delay



Notes:-

(i) All intergreens are set to 6 seconds.
(ii) Hold time (SIE) set to 7 seconds.
(iii) 1st RLM fail active.
(iv) Losing phase delay of 6 seconds set from phase C.
(v) Phase C only conflicts with phase H.

19.3 L.M.U. PARALLEL STAGE STREAMING FACILITIES

19.3.1 LMU Supplementary Intergreen Extensions

There is an LMU supplementary intergreen extension facility available for each stream. If an LMU indicates one red lamp fail (see Section 19.2) then the all red period of the intergreens on the configured stage to stage movements will be held until the supplementary extension timer expires. The extension period is measured from the stage change point. Each stream's extension can be accessed by using the handset command:

SIE followed by the stream number (e.g. SIE 2). Data is in the range 0 to 31.8 seconds in 0.2 second steps.

19.3.2 LMU Maximum All Red

There is an LMU maximum all red facility available for each stream. If an LMU indicates a second red lamp failure pending (see section 19.2) then the all red period of the intergreens on the configured stage to stage movements will be held until the LMU maximum all red timer expires. The maximum period is measured from the stage change point. Each stream's maximum can be accessed by using the handset command:

LMX followed by the stream number (e.g. LMX 0). Data is in the range 0 to 255 seconds in 1 second steps.

19.4 SET UP CONNECTIONS FOR RED LAMP MONITORING

Installation is in accordance with Lamp Monitoring Unit Handbook 667/HB/17330/000 Section 5. The pre-installation are detailed in Section 4 and should be as follows:

19.4.1 Link Pin Connections

Output State Watchdog fail:-	LINK 1	Pins 1 and 3	(standard - Open CCT)
Mains Voltage Supply:-	LINK 7	Pins 2 and 3	(for 240v)
Watchdog Retry Count:-	LINK 11	Pins 1 and 4	(standard - 7 Retries)

19.4.2 Configuration Switch (SW1)

(See Handbook Section 4.4 for full details)

BIT No.	7	6	5	4	3	2	1	0
SWITCH No.	8	7	6	5	4	3	2	1
ON or OFF	1	1	1	1	1	0	0	0

A CLOSED (ON) SWITCH = 0
AN OPEN (OFF) SWITCH = 1

SWITCH 6 / BIT No. 5

When SWITCHED SIGNS are being monitored this switch is set CLOSED otherwise set it OPEN.

19.4.3 LMU Output Connections To Controller Inputs

LMU Connection PL4	LMU Output	T400 Input Terminal	Input Reference	MCK1061 Reference
Pin 1 (+ve)	0	SEE WORKS SPEC.	LMU1	INDICATION 1
Pin 3 (+ve)	1		LMU2	INDICATION 2
Pin 5 (+ve)	2		LMU3	INDICATION 3
Pin 2 (-ve)	Linked Together & Connected to T400 Terminal TN3 and TN4			
Pin 4 (-ve)				
Pin 6 (-ve)				

19.4.4 Configuration Requirements

Starting Intergreen:	A value of 8 seconds is required to enable the LMU to learn the intersection
LMU Supplementary Intergreen Extension Time:	This should be set to 6 seconds (3 second amber and 3 second red) to give 3 second all red when Indication 1 is active (see section 2.6.7).
LMU Max All Red Time:	Set this to 11 seconds (3 second amber and 8 seconds red) to give 8 seconds all red when Indication 3 is active (see section 2.6.8).
Allocation of Ports:	The three controller inputs LMU1, LMU2 and LMU3 must be allocated so that they do not use an input port on the SDE/SA card, because the inputs are active low and on power up, the SDE PCB sets all I/P signals low, thus producing a spurious failure indication.

With all pedestrian stages, an opposing demand is required to give minimum green termination upon second red lamp failure being detected (Indication 2). A demand must therefore be inserted by complex conditioning to cause the stage to terminate in the absence of opposing demands with Indication 2 becoming active.

Care must also be taken to ensure that any pedestrian demands introduced as a result of Indication 2 being detected are conditioned such that they do not allow any other Phase maximum to be started unnecessarily.

Red Lamp Monitoring is specified in MCK 1061 and MCK 1057 (these amend MCE 0141) as being required when an exclusive pedestrian stage is provided with audible or tactile indicators. If it is requested to have red lamp monitoring with parallel pedestrians then the following method of working has been agreed:
There must be no conflicting vehicle movement with the pedestrians, and all red signals protecting the pedestrian must be monitored. Also in this case Tactile Indicators must be used <u>NOT</u> Audibles.

At the time of configuration, it is possible to set the controller fault log, by conditioning, when any of the LMU inputs are active.

20. SPECIAL CONDITIONING

20.1 INTRODUCTION

There are often special requirements for the operation of a controller which are not covered by its normal methods of working. This is normally due to the peculiarities of a particular intersection. For example it may be a requirement that demands for a particular phase are inhibited during the first six seconds of appearance of another phase, or a demand for a particular phase is inserted when there is a demand on another phase and an extension on another, etc. This type of facility can be catered for by Special Conditioning.

The operation required by Special Conditioning is specified at configuration and the data is located in the configuration PROM. This data forms a special software language which is interpreted by the T400. The types of functions that can be performed are described below.

20.2 SPECIAL CONDITIONING OPERATORS

A large selection of controller variables can be read from Special Conditioning, and a smaller selection of variables can be written to which will then modify the operation of the controller. A number of logical operations can be performed on variables which have been read. These include the logical operations of 'NOT', 'AND', 'OR' and 'EXCLUSIVE OR'. Conditional and unconditional jumps can be performed. The values of certain variables can be tested to see if they are 'EQUAL' to a specified value or 'GREATER' than a specified value. There are Special Conditioning timers which can be run and tested from within Special Conditioning.

20.3 SPECIAL CONDITIONING EXAMPLES

The following list is included to indicate the type and range of facilities that can be provided by Special Conditioning:-

- Fixed time to current max
- Stages appearing more than once per cycle if many stages
- Intergreens extended by curtailed extensions
- LRT prevent moves
- Ped audibles deleted by time of day
- Dimming by time of day
- Linking to remote pedestrian controllers or other controllers
- Fault recognition of pedestrian controllers
- Limit Green timer
- Hurry call watchdog
- CLF plans affecting VA operation
- Instigation of Flash Amber Mode due to Fault
- Pelican Link
- Holding a stage with a Special Conditioning timer

20.4 READING CONTROLLER TIMERS

It is possible to read whether certain controller timers are active, held or expired, and also what the count value is.

Following is a list of timers which have the above facility:

Minimum
Extension
Maximum
Delay
Sequence
Intergreen
2nd-ary Intergreen
Hurry Delay
Hurry Hold
Hurry Prevent
Conditioning
Call/Cancel
Priority Extension
Priority Maximum
Priority Inhibit
General
Compensation
Fixed
Window
Hold Intergreen Maximum
Hold Intergreen Extension

General/Sequence. These are timers which are not available to the traffic engineer but are essential to the correct operation of the controller, e.g. start-up, data set ready, handset timeout, background checks, start up switch to bright.

Note the timers cannot be loaded with a value in conditioning and the actual count value cannot be read. Only logical expressions can be performed, i.e. count equal to ‘x’ or count greater than ‘x’.

Example

If a side road phase is extending towards its maximum and a demand is inserted for the main road, providing the side road max timer has exceeded 20 seconds then the extensions may be prevented, to allow the main road phase to gain ROW immediately.

<table>
<tr><td colspan="3">Phase B at green and demand present for phase A?</td></tr>
<tr><td colspan="2">YES</td><td>NO</td></tr>
<tr><td colspan="2">Phase B max timer > 20 ?</td><td rowspan="3">Do nothing</td></tr>
<tr><td>YES</td><td>NO</td></tr>
<tr><td>Prevent phase B extensions</td><td>Allow phase B extensions</td></tr>
<tr><td colspan="3">END</td></tr>
</table>

MAIN ROAD = PHASE A
SIDE ROAD = PHASE B

20.5 SPECIAL CONDITIONING WITH CONTROLLER CONFIGURING SYSTEM

(Supplied Separately from Controllers)

Within the controller configuring system (The Configurator) files containing special conditioning code can be stored and used as a library. Allowing commonly used items of special conditioning to be recalled for use at any time. For further details see the Configurator Handbook.

21. EXAMPLE OF AN INTERSECTION

This section consists of an example of an intersection using Siemens MCE 0141 - General Specification Forms.

As many facilities as possible have been incorporated but it must be appreciated that no controller would have every facility programmed.

Figure 21.1 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.2 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.3 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.4 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.4a - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.5 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.6a - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.6b - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.7 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.8 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.8a - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.9 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.9a - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.9b - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.10 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.11 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.12 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.13 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.14 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.15 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.16 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.17 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.18 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.19 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.20 - CUSTOMER SPEC SHEET EXAMPLE

Figure 21.21 - CUSTOMER SPEC SHEET EXAMPLE

22. EXAMPLE OF AN INTERSECTION ROAD TRAFFIC & LIGHT RAIL VEHICLES

This section consists of an example of an intersection using Siemens MCE 0141 - General Specification Forms. 667/DJ/20200/010.

Only the 0141 forms required for this particular example are included. For the complete set of forms see the document above.

As many facilities as possible have been incorporated but it must be appreciated that no controller would have every facility programmed.
The control of this generalised junction is not Controller specific and some of the T400's capabilities/facilities are not used or identified in the specification sheets. e.g. Linked Fixed Time.

NOTE Any dummy phase(s) used will be specified as the next phase(s) after all the hardware phases. i.e. If four hardware phases are used (A to D) the first dummy phase would be phase E.

Figure 22.1 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.2 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.3 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.4 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.5 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.6 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.7 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.8 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.9 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.10 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.11 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.12 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.13 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.14 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.15 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.16 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.17 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.18 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.19 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.20 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.21 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.22 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.23 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.24 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.25 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.26 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.27 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.28 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.29 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.30 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.31 - CUSTOMER SPEC SHEET EXAMPLE

Figure 22.32 - CUSTOMER SPEC SHEET EXAMPLE

23. MOVA (MICROPROCESSOR OPTIMISED VEHICLE ACTUATION)

At present, MOVA is implemented in separate units which monitor the movement of vehicles through an intersection via their own independent loops and then adjust the operation of the controller to optimise traffic flow.

These units are interfaced to the controller via the controllers UTC interface which allows the units to influence the controller.

23.1 INSTRUCTIONS FOR CONNECTING MOVA TO TRAFFIC CONTROLLERS

1. Stage Green confirms and, where required, phase green confirms will be open circuit during green. They will be short circuit at other times except as detailed in item 3.

2. Ready to control bit will be short circuit during normal operation, except as detailed in item 3, and open circuit when manual control is operational.

3. Stage green confirm 1 and 2 and ready to control bits will all be open circuit during the following conditions:

   a) Manual Control
   b) Selected Fixed time if available
   c) Selected VA time if available
   d) Signals switched off (manually or fault log)
   e) Lamp Supply fuse blown

   Note: On older controllers, the ready to control bit need not be open circuit for all these conditions as long as the double green is output.

4. Force bits closed contact provides the force signal. The force may be either demand dependent or not, depending on customer request. If the force is demand dependent, then DX bit closed contact must insert an unlatched demand for that stage whilst the force bit is present. This then ensures that when the forces disappear the controller will work correctly to street demands only and not be affected by the state of the DX bit. Note: if there are no demand dependent forces, then DX will not be set.

5. Common detectors including Push Buttons - none of these will be driven from the controller ports using conditioning.

The output of the detector/pushbutton can be wired directly both to the controller input and the MOVA input. Usually the detector will be configured as open circuit equal to vehicle present.

Normally, these wires/signals to and from the MOVA unit will be listed in the spec. to wire to the individual points of the controller, i.e. UTC interface blocks, the detector input terminal blocks, the pushbutton terminal blocks etc.

However, some customers will ask for the push buttons to be wired via the UTC interface. In this case, all signals except the pushbuttons will be listed as above, but the MOVA connections for the pushbuttons inputs will be wired to the correct UTC interface reply terminal block. The existing wiring on these terminals which comes from the buffer cards should be removed and tied back. Additional wiring should then be provided to link the Push Button input terminals to the UTC interface reply terminals.

24. GAS PLINTH

24.1 GENERAL DESCRIPTION

A gas plinth can be fitted below the controller to prevent ground-permeating gases from entering the controller; the gas is allowed to escape via the vented plinth. All cables entering into the controller must pass through the gas plinth with cable glands being used to seal the cables. There is a maximum number of cables which can enter the controller when a gas plinth is used, as detailed below:

Small case controller - 18 cables (Including electrical supply)
Large case controller - 27 cables (Including electrical supply)

If required, a Cable Earth Termination (CET) may be used to support and terminate the cables inside the Controller. This method of termination is shown on the drawing 667/GA/21150/etc.

25. ANCILLARY PROCESSOR (Integral OTU/LMU/RLM)

25.1 GENERAL DESCRIPTION

The Ancillary Processor is a double extended Euro sized PCB which connects to the T400 Main Processor via the Extended System Bus. Configuration information for the Ancillary Processor comes from the Configuration PROM on the T400 Main Processor PCB. Handset access to the Ancillary Processor is via the handset socket on the Main Processor board.

25.1.1 FUNCTIONAL APPLICATIONS

25.1.1(a) Integral/Enhanced Red Lamp Monitor

The RLM function is required at part-time signals and at junctions which are fitted with pedestrian audible or tactile devices. The vehicle red lamps are monitored and when lamp failures are detected, the operation of the controller is modified to ensure that unsafe signal conditions do not occur.

The basic differences between this RLM facility and the original described in section 19, is that this facility provides:-

- eight indepandant RLM ‘groups’, i.e. eight 1st and 2nd fail indications,
- greater configuration flexibility to action the failures,
- a much faster response time,

The RLM function is provided by the T400 firmware operating in conjunction with the Ancillary Processor card. The hardware comprises of a T400 ancillary processor card (667/1/02239/001), together with current monitoring transformers (toroids) and a voltage monitoring transformer. The ancillary processor card resides in the T400 module rack and communicates with the T400 main processor card via the extended system bus ribbon cable. (The T400 can also operate with a free standing RLM unit, giving reduced facilities - see section 25.4.3.)

One current sensor per vehicle phase and one per pedestrian phase with wait boxes is required for full lamp monitoring. So a 16 phase controller will have 16 current sense transformers, each transformer having the wires feeding the red, amber/wait and green signals passed through the toroid. For part time and Audio/Tactile sites, only the opposing vehicle phases need be equipped with current sensors.

This RLM function, which applies to intersection controllers, should not be confused with Pelican Red Lamp Monitoring, which is specific to Pelican crossings (i.e. MCE0125, MCE0145) and is implemented in hardware on the T400 2-phase drive card.

On detection of first red lamp failure the RLM response is :-

- The T400 system LED is illuminated.
- DFM lamp flashes.
- The appropriate phases are delayed by a preset amount (specified in the T400's configuration) to allow extra time for drivers to realise that a red is present on this approach.
- Internal fault log is set.
- If the controller is configured to output 'any fail' and 'any red' signals then these are activated on the configured output bits.
- If configured, the Red Lamp Fail 1 bit is set

On detection of second red lamp failure on same approach, the controller response is :-

- The DFM Lamp remains flashing and the T400 system LED remains illuminated.
- Fault logs are set to indicate a second red lamp failure.
- If the controller is configured to output 'any fail' and 'any red' signals then these remain activated on the configured output bits.
- If configured, the Red Lamp Fail 2 bit is set

For pedestrian RLM :-

- The appropriate pedestrian phases are inhibited, as configured for that RLM group. Note if the pedestrian phase is already active or is within 500ms of going active, then the pedestrian phase will be run for its minimum period and on subsequent cycles be inhibited.
- The wait indicators are illuminated for all inhibited pedestrians.

For part time junction RLM :-

- The phases on the stream or streams are switched off. This is to ensure the approaching driver doesn't think the signals are off and drives through a failed red, resulting in an accident.

Red Lamp Monitor Operation

1. The voltage monitor transformer measures the actual voltage on the signals, to allow the current readings to be tracked against actual voltage.

2. The Ancillary processor assesses if a lamp failure has occurred, and counts the number of failures against each colour and phase.

3. The lamp failure information is sent to the T400 over the extended system bus. The T400 then takes this lamp failure indication and compares it to the configuration and takes the appropriate action.

   Lamp failures occurring whilst the lamp is illuminated, and after the expiry of an additional 500mS delay at start of illumination of the red, will be acted upon within 500mS.

   Lamp failures that occur while the lamp is not been powered or that occur during the first 500mS that the lamp is powered, will be acted upon within one second from the start of the lamp being powered.

   The additional 500mS delay at the start of a red period is to ensure that all surges have reduced to an acceptable level (as discussed at the 141 meeting on the 16/5/95).

4. The T400 lamp faults can be sent to the central office by an OTU (either integral or free-standing).

25.1.1(b) Lamp Monitor (Integral)

To detect bulb failures and report to other manufacturers' OTU's and UTC Systems.

25.1.1(c) OTU (Integral)

To provide an Outstation Transmission Unit for use in a TC12 Data Transmission System. This may also incorporate the functions of LMU and RLM.

Note: the OTU function of this Ancillary Processor is not required for LMU or RLM, but it is capable of carrying out this function as well, although the Integral OTU is not currently BABT approved for use in the UK.

25.1.2 PHYSICAL DESCRIPTION

25.1.2(a) Mechanical Construction

The PCB is located within the T400 PCB Module, along side the other T400 Logic PCB's. It interfaces to the T400 Main Processor PCB via the Extended System Bus ribbon cable, in a similar way to the existing SDE/SA PCB.

25.1.2(b) Current Sensors & Voltage Monitor

There is a connector on the PCB to allow connection of the current sensors and a voltage monitor which are used for Lamp Monitoring.

25.1.2(c) Telephone Line Interface (OTU)

There is a BT style Jack provided to allow 2 or 4 wire leased line connection, when used as an integral OTU.

25.1.2(d) Test Jack Sockets (OTU)

A Jack socket is provided to allow connection of a TC12 Instation Test Set, for use in UTC systems. This permits monitoring of line levels and communication data during installation and maintenance etc.

25.1.3 ANCILLARY PROCESSOR PCB ELECTRONICS

The Ancillary Processor PCB is based on the Intel 80188 microprocessor, which is the same processor as used on the T400 Main Processor PCB. Please refer to Figure 25.1 for a functional block diagram of the Ancillary Processor PCB.

The peripherals to the processor are the:

Firmware PROM
RAM (battery supported)
Shared RAM ('shared' with the T400 main processor)
A to D Converter with Analogue Multiplexer
Serial Interface (USART) with integral Modem and Line Interface
Watchdog Monitor Facility
Status LED Indicators

Note that there is no configuration prom on this PCB as all the data is obtained from the T400 configuration prom.

25.2 ANCILLARY PROCESSOR CARD INSTALLATION

25.2.1 General

Installation and commissioning of the ancillary processor is carried out in the following order:

- Configure the ancillary processor PCB via PCB switches
- Install PCB in Controller and Connect the cabling
- Configure and commission the ancillary processor using the Handset terminal

The parameters that need configuring include:-

(1) Output power level
(2) Receive Threshold
(3) 2 or 4 wire line connection
(4) Ohm or High Impedance line termination
(5) Baud Rate/Mode
(6) Outstation Address
(7) Number of Outstations on the line
(8) Number of control bytes for all Outstations on the line
(9) Number of reply bytes for all Outstations on the line
(10) Reply Bit Function
(11) Lithium Battery isolation switch
(12) LMU Information (see the LMU section)
(13) Fault Flag and Data Displays

(1),(2),(3),(4) and (11) above are configured using switches on the PCB, as described below. All others are configured using the handset terminal.

(1)-(10) only apply to the ancillary processor if it is be used as a TC12 UTC Outstation Transmission Unit (OTU). If the ancillary processor is not being used as an OTU, parameters (1)-(10) can be ignored.

25.2.2 Configuring the Ancillary Processor PCB

Figure 25.1 shows a diagram of the Ancillary Processor PCB layout. The position of the switches, connectors, and status LED's are shown.
Ensure that the correct variant of the PCB has been supplied against the Works Specification, if this is available.

25.2.3 Safety Warning

The Ancillary Processor PCB contains a lithium battery. Care must be taken with the use and disposal of this battery. The handling precautions in code of practice CP526 must be followed.

25.2.4 Cover

The PCB is fitted with a cover (part number 667/2/25192/000 front, 667/2/25193/000 rear).
The cover must ALWAYS be fitted before any cables are installed, and should NEVER be removed whilst the telephone cable (from socket SK1 on the PCB) is connected to the telephone network.
In the UK, removal of this cover invalidates BABT approval.

If the PCB is for RLM only, it may be sub-equipped. In this case, the telephone socket and associated electronics are not fitted, and thus, no cover is required.

25.2.5 Configuring the Switches on the Ancillary Processor PCB

Before any connectors are attached to the Ancillary Processor PCB, the configuration switches need to be set up as described below. Figure 25.1 shows the position of the switches on the PCB and the directions to set the switches to for different options.

There are 4 switches on the PCB:

S1 - 2/4 Wire Select Switch
S2 - Lithium Battery On/Off Switch
S3 - Line Level Switch
S4 - 600 Ohm/High Impedance Switch

(If the PCB is not being used as an OTU, switches S1, S3 and S4 can be ignored.)

These are set as follows;

1. **S1 - 2/4 Wire Select Switch**
   Set to either 2 or 4 wire as required by the position indicated on the installation sheet for the Integral OTU.
2. **S2 - Lithium Battery On/Off Switch**
   Set the Lithium Battery Switch (S2) to ON.
3. **S3 - Line Level Switch**
   Ensure that the Line Level switch (S3) is set to the required line levels. These are stated on the installation information sheet for the Integral OTU. The table below shows switch settings corresponding to the different levels. Switch S3 is a 6-way DIL switch. Switch positions 1 to 4 set the Output Power and switch positions 5 and 6 set the Receive Threshold.

Output Power	1	2	3	4	Receive Threshold	5	6
0 dBm	1	0	0	0	-42 dBm	0	0
-3 dBm	1	0	0	1	-39 dBm	0	1
-6 dBm	0	1	0	0	-33 dBm	1	0
-9 dBm	0	1	0	1			
-10 dBm	0	0	1	0			
-13 dBm	0	0	0	0			
-16 dBm	0	0	0	1			

4. **S4 - 600 Ohm/High Impedance Switch**

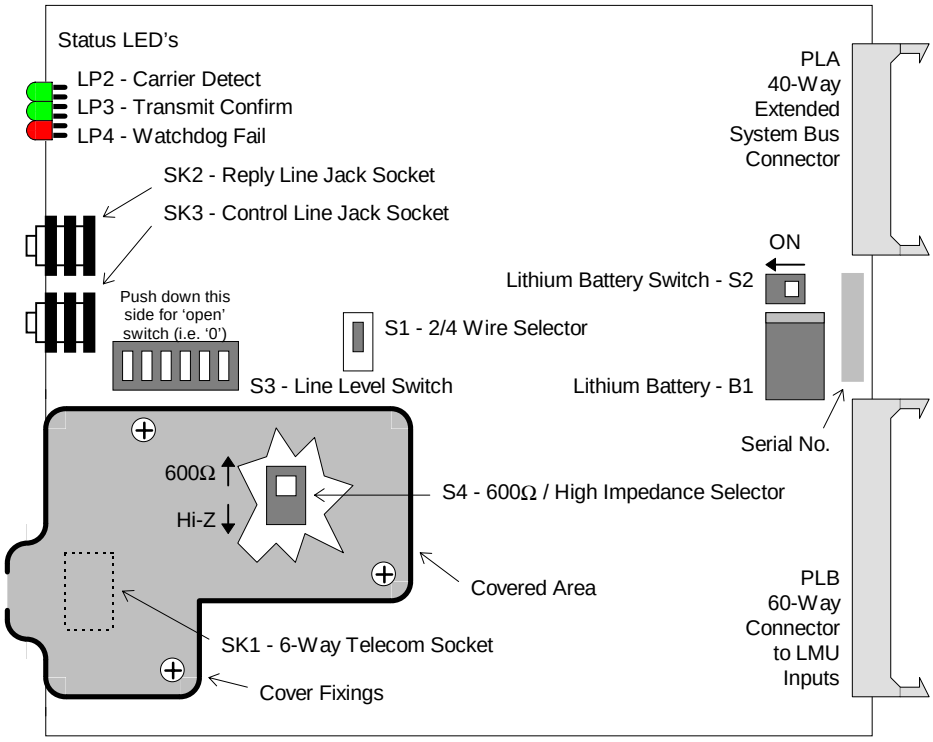
Switch S4 - Installation
(To be performed by qualified/authorised installation/service engineer.)

WARNING - THIS SWITCH IS LOCATED UNDER THE PCB COVER. FOR UK USAGE THERE ARE NO USER ACCESSIBLE PARTS UNDER THE COVER. BABT APPROVAL WILL BE INVALIDATED IF THE COVER IS LEFT OFF OR MISSING.

This switch is always set to the 600 Ohms position for all Radial, Multi Point and/or Multi Terminal lines. The switch is set to 600 Ohms during manufacture and therefore does not need to be changed. Where British Telecom or other telephone line supplier has agreed to provide Multi-drop circuits i.e. where more than one OTU is to be connected to one line, the final OTU on the line is set to 600 Ohm, all others on the line need to be set to high impedance. Then the switch may be set as appropriate for the OTU, as noted below.

Note to Service / Installation engineers:-
This switch is located underneath the cover. The top half of the cover should be removed in order to set the switch. No cabling should be connected at this stage, but before removing the cover make sure that the cable connected to socket SK1 of the PCB is not connected to the telephone network. Ensure the cover is re-fitted correctly after setting the switch.
Make a note of the switch setting on the OTU installation sheet for future reference.

Figure 25.1 - Ancillary Processor PCB Layout


Status LED's
LP2 - Carrier Detect
LP3 - Transmit Confirm
LP4 - Watchdog Fail
SK2 - Reply Line Jack Socket
SK3 - Control Line Jack Socket
Push down this side for 'open' switch (i.e. '0')
S3 - Line Level Switch
S1 - 2/4 Wire Selector
PLA 40-Way Extended System Bus Connector
ON
Lithium Battery Switch - S2
Lithium Battery - B1
Serial No.
600Ω
Hi-Z
S4 - 600Ω / High Impedance Selector
Covered Area
SK1 - 6-Way Telecom Socket
Cover Fixings
PLB 60-Way Connector to LMU Inputs

25.2.6 Connectors and Cables

25.2.6(a) Extended System Bus Ribbon Cable

Connect the T400 extended system bus cable to Plug PLA on the back of the Ancillary Processor PCB.

NOTE: Do not connect/disconnect the cable whilst the controller power is switched on.

25.2.6(b) Telephone Cable with 6-way Plug

If the installation uses the TC12 outstation facility then the OTU comes fitted with a telephone cable terminated in a 6 way telecom plug. Connect the telephone plug to the telephone socket in the traffic control equipment.

NOTE: The cable should never be disconnected from the PCB Socket SK1, whilst the other end is connected to the telephone network (via the network termination unit). In order to prevent the cable being disconnected from the PCB by accident, the PCB cover fits around the end of the plug on the cable, in order to retain it.

25.2.6(c) Lamp Monitor Unit Connections

If the installation uses the lamp monitoring facility then Current and Voltage monitoring transformers are connected to PLB on the Ancillary Processor PCB via a 64-way connector housing (part number 508/4/26138/008). The current and voltage monitor transformers have 2 wires each, terminated in crimps which push in to the connector housing.

Note - only 60 positions are used on the 64 way housing. Positions 1,2,63 and 64 are unused as they do not line up with any of the 60 pins on the plug PLB.

Figure 25.2 shows the pin out of PLB.

LMU input 1+ and LMU input 1- (PLB pins 1 and 2), correspond to positions 3 and 4 respectively on the 64 way housing and so on.

Figure 25.2 - LMU Input Connector

PLB Pin	Name	Berg Pin	PLB Pin	Name	Berg Pin
1	Sensor 1+	3	31	Sensor 16+	33
2	Sensor 1-	4	32	Sensor 16-	34
3	Sensor 2+	5	33	Sensor 17+	35
4	Sensor 2-	6	34	Sensor 17-	36
5	Sensor 3+	7	35	Sensor 18+	37
6	Sensor 3-	8	36	Sensor 18-	38
7	Sensor 4+	9	37	Sensor 19+	39
8	Sensor 4-	10	38	Sensor 19-	40
9	Sensor 5+	11	39	Sensor 20+	41
10	Sensor 5-	12	40	Sensor 20-	42
11	Sensor 6+	13	41	Sensor 21+	43
12	Sensor 6-	14	42	Sensor 21-	44
13	Sensor 7+	15	43	Sensor 22+	45
14	Sensor 7-	16	44	Sensor 22-	46
15	Sensor 8+	17	45	Sensor 23+	47
16	Sensor 8-	18	46	Sensor 23-	48
17	Sensor 9+	19	47	Volt. Mon+	49
18	Sensor 9-	20	48	Volt. Mon-	50
19	Sensor 10+	21	49	N/C	51
20	Sensor 10-	22	50	N/C	52
21	Sensor 11+	23	51	N/C	53
22	Sensor 11-	24	52	N/C	54
23	Sensor 12+	25	53	N/C	55
24	Sensor 12-	26	54	N/C	56
25	Sensor 13+	27	55	N/C	57
26	Sensor 13-	28	56	N/C	58
27	Sensor 14+	29	57	N/C	59
28	Sensor 14-	30	58	N/C	60
29	Sensor 15+	31	59	N/C	61
30	Sensor 15-	32	60	N/C	62

Current Transformers

Each controller phase or illuminated indicator that is to be monitored requires 1 current sensor as detailed below. The table also indicates which lamp feeds are passed through the current sense transformer for each type.

Monitorable Lamp/phase types	Current sensor lamp feeds	Maximum number of Signal Heads (see note 1)
Intersection Vehicle (IV)	R, A, G	16 { 6 }
Pelican Vehicle (PV)	R, A, G	16 { 6 }
Intersection Pedestrian (IP)	Rm, Gm	16 { 6 }
Pelican Pedestrian (PP)	Rm, Gm	16 { 6 }
Wait Indicator 40Watt (W4)	Wt	16 { 6 }
Wait Indicator 60Watt (W6)	Wt	16 { 6 }
Regulatory Sign (RS)	Sign	7 signs (21 tubes) {2 signs (6 tubes)}
Switched Sign - Bulb type (SB)	Sign	16 lamps {6 (note5)}
Switched Sign - Tube type (ST)	Sign	7 signs (21 tubes) {2 signs (6 tubes) note 4 }
Pelican Pedestrian and Wait (PPW and PP4)	Rm, Gm, Wt	16 (note 2) { 6 }
Pelican Stream (PS and PS4)	R, A, G, Rm, Gm, Wt	16 (note 3) { 6 }
Intersection Ped. & Wait (IPW and IP4)	Rm, Gm, Wt	16 (note 2) { 6 }
Intersection Ped. Stream (IPS and IS4)	R, A, G, Rm, Gm, Wt	16 (note 3) { 6 }
Export Pedestrian with flashing Red (XP1)	Rm, Gm	16 { 6 }
Export Vehicle with flashing Green (XV1)	R, A, G	16 { 6 }
Export Vehicle Filter flashing Amber Ball (XV2)	Flashing Ball	16 { 6 }
Export Vehicle - flashing Amber signal group (XV3)	R, A, G	16 { 6 }

Note 1:

These limits apply to 240W rms supply voltage and 50W lamp loads (unless stated). Where the supply is lower or the lamp loads are higher the limits are reduced accordingly. For example the figures given in curly brackets {}, are the maximum loads when a 50-0-50 Vrms mains supply is used. The limits are only reduced if the actual voltage being monitored is at the lower level, i.e. if a 50-0-50 Vrms supply (derived from a transformer) is used but the monitoring is on the 240V rms side of the transformer, then the limits do not need to be reduced.

If the nominal load current (excluding red/ambers) of a particular controller output exceeds 4.0A rms., at nominal mains voltage, then that output should be split and treated as two separate outputs.

Note that for red lamp monitoring, no more than 10 x 50W halogen bulbs (or equivalent loading) should be monitored by a current sensor performing RLM. The recommended limit is therefore 8 signal heads per red lamp monitored vehicle phase, or, if the phase controls more than one approach, 8 signals heads per approach and each approach monitored separately. Also note that any red lamp monitored vehicle phase, can only be split on an approach basis - any one approach cannot be monitored by two or more sensors since a single bulb failure on each sensor is not accumulated into a second red lamp failure. It is recommended that a red lamp monitored vehicle phase controlling more than one approach is actually split into one phase for each approach when the controller is configured.

Note 2:

For example, 8 pedestrian plus 8 wait indicator.

Note 3:

For example, 8 vehicle plus 4 pedestrian plus 4 wait indicator.

Note 4:

To allow monitoring of tube type signs at 50-0-50 Volt sites, the signs must be driven with the 50-0-50 Volt supply and the tubes must have the standard voltage-current characteristic.

CAUTION

The current sensors may produce a high voltage if current is passed through the core when they are not terminated into the OTU board.

The Current transformers (part number 667/7/25171/000) measure the current flowing in conductors that are passed through their core. To maintain the correct relationship between the current flowing in the conductors and the output from the sensor, the sensors must be connected the correct way round.

The current transformers are toroidal and one side is marked with a spot to indicate the input direction. The Live conductor(s) should pass from the controller output terminal(s) through the centre of the current transformer, entering the side with the spot marker, and on to the lamp(s).

The output wires from the current transformer are red (positive) and white (negative) and are terminated with Berg mini PV terminals which are clipped into a Berg mini latch housing to provide a complete sensor assembly which plugs into PLB on the ancillary processor. Referring to Figure 25.2, the red wire connects to the required number LMU input shown with a +, and the white wire connects to the corresponding - input. Inputs should normally be allocated consecutively starting from number 1. The

current sensors should then be anchored by passing a TYWRAP or equivalent through the sensor hole and around a suitable fixing point.

Up to 23 current transformers can be used per Outstation when equipped with LMU facilities. However, it is recommended that one current transformer is assigned to monitor one complete controller phase (including wait indicators of pedestrian phases), i.e. one sensor per phase.

Voltage monitoring transformer

A Voltage monitoring transformer (part number 667/7/25172/000) is used per Outstation when equipped with LMU facilities. The red and black wires connect to the lamp supply mains live and neutral being monitored (Red to Live and Black to Neutral). The orange and white output wires connect to PLB. Referring to Figure 25.2, the orange wire connects to pin 47 (i.e. pin 49 on the Berg mini latch) and the white wire connects to pin 48 (i.e. pin 50 on the Berg mini latch).

The transformer should then be anchored to a suitable point in the cabinet.

Voltage Sensors

Voltage sense transformers (667/1/22734/000) are not required with the Integral Ancillary Processor PCB. All the information on which colours are being driven is obtained from the ‘aspect drive’ information passed from the T400 Main Processor over the extended system bus.

25.2.7 Effect of Incorrect Switch Settings on the Ancillary Processor PCB

(i) S1 - 2/4 Wire Select Switch
4 wire system but with 2 wire selected in error or 2 wire system but with 4 wire selected in error; the OTU may not receive the control signal and will not reply, therefore the carrier detect and transmit confirm LED's will be OFF.

(ii) S2 - Lithium Battery On/Off Switch
If this switch is off the system fail LED will illuminate on the T400 Main Processor PCB and the Integral OTU will not communicate with the Instation.

(iii) S3 - Line level switch
A 6-way DIL switch is used to set line levels. If switch positions 1 to 4, of the DIL switch, are set incorrectly the OTU will transmit at the wrong output power.
If switch positions 5 and 6 are set incorrectly the receive threshold for the OTU modem will be wrong. If it is set too low corrupted control messages may occur. If set too high the control messages from the Instation may be undetected.

(iv) S4 - 600 Ohm/High Impedance Switch
If the switch is set to high impedance when it should be set to 600 Ohms, the transmit signal for all OTU's on the line and the receive signal for the particular OTU will be up to 3dB higher than if the switch was set correctly. The characteristics of the line may also be affected.
If the switch is set to 600 Ohms when it should be set to high impedance this will reduce signal levels and may upset the characteristics of the line.

25.2.8 Fault Finding at the Outstation

Symptom	Possible Reason
System Fault LED lit on T400 Main Processor	- Use handset to access fault log for information on the type of fault that has occurred, this may be an Integral Ancillary Processor fault.
Watchdog LED On	- Software not running correctly. Attempt to discover the cause using the controller handset commands OTS and OTH, and then power off and back on.
OTU not replying to control message	- OTU Switch settings incorrect. - OTU configured incorrectly via the handset, repeat configuration. - Extended system bus cable disconnected or faulty. - No control data - low line level, interference, or BT lead disconnected/faulty.
The lamp monitor will not learn the junction or will not detect lamp failures	- There are entries in the fault log which indicate the reason - e.g. faulty voltage monitor or its connections. - The lamp monitor is not enabled (KLE handset command). - The controller's signals are off. - The lamp monitor connector is not connected to PLB. - Use the KAC handset command to check the lamp monitor is taking readings.

25.2.9 Lithium battery

The outstation PCB is fitted with a Lithium Battery (B1, part number 418/4/97186/000),
This battery must be **Replaced** every **4** years. The battery has a label attached to it with the date by which the battery should be replaced. When replacing the battery, label the new one with today's date plus 4 years'.

WARNING: Care should be taken when handling/disposing of Lithium batteries. Refer to code of practice CP526.

25.2.10 Recommended Spares

General Spares:

Ancillary Processor PCB	667/1/21611/001 (Note swap IC32 PLD and IC26 Firmware EPROM, from old board to new board when making replacement)
Lithium battery	418/4/97186/00

LMU Spares (if equipped):-

Current Transformer	667/7/25171/000
Voltage Monitoring Transformer	667/7/25172/000

25.3 RLM GENERAL DESCRIPTION

25.3.1 Background Information

The RLM facility is required at part-time signals and at junctions which are fitted with pedestrian audible or tactile devices. The vehicle red lamps are monitored and when lamp failures are detected, the operation of the controller is modified to ensure that unsafe signal conditions do not occur.

The RLM function is provided by the T400 firmware operating in conjunction with a RLM unit. The RLM unit hardware comprises a T400 ancillary processor card (666/1/02239/001), together with current monitoring transformers (toroids) and a voltage monitoring transformer. The ancillary processor card resides in the T400 module rack and communicates with the T400 main processor card via the extended system bus ribbon cable. The T400 can also operate with a free-standing RLM unit, giving reduced facilities.

This RLM function, which applies to intersection controllers, should not be confused with Pelican Red Lamp Monitoring, which is specific to Pelican crossings (i.e. MCE0125, MCE0145 and Puffin) and is implemented in hardware on the T400 2-phase drive card.

25.3.2 Overview

For earlier installations, a separate mains powered RLM unit may be employed. In this case, the RLM facilities available are reduced. The combinations of facilities and equipment which are available are summarised in the table below.

Equipment	RLM Operation	RLM Signals Available
free-standing RLM unit	original RLM all red.	RLF1, RLF2 & RLF3.
free-standing RLM unit	enhanced RLM phase delays and inhibits on first RLM group only.	RLF1 & RLF2. Caution: RLF3 is not supported.
integral RLM unit	original RLM all red.	RLF1 & RLF2 for first RLM group only. RLF3 is not required.
integral RLM unit	enhanced RLM phase delays and inhibits.	RLF1 & RLF2 for up to 8 RLM groups. RLF3 is not required.

25.4 ENHANCED RLM DETAILED DESCRIPTION

In descriptions below, references (C1), (C2) etc. refer to individual configuration items described in section 25.4.5.

25.4.1 Operation On First Red Lamp Fail

25.4.1(a) Phase Appearance Delays

When the first red lamp fails (RLF1 indication) on a RLM group, the controller delays the appearance of selected phases by configurable time periods.

The selection of which phases are delayed by a RLM group is made by means of configuration data (C1).

The times by which the phase appearances are delayed, are configured for each phase to phase change (C2 & C7). The actual delay applied to each phase (in addition to the normal intergreen / variable all red) is the sum of:-

1) the RLM delay time for the phase,
plus 2) the longest time in the RLM phase-phase delay offset table which is applicable to the phase to phase changes being made.

Phases can be configured with zero delay time in the RLM delay time array and in the RLM phase-phase delay offset table, and thus will appear at their normal times.

RLM delay offsets can be applied to a phase, even though the phase appearance is not controlled by any intergreen times i.e. where none of the phases losing right-of-way conflict with a phase gaining right-of-way, the phase gaining right-of-way can still have an RLM delay applied if this is specified in the RLM phase-phase delay table.

The RLM delay time (C7) for each phase can be altered via the handset. A range check is applied to delay times entered via the handset and out of range values are rejected. The high and low range limits are set in the T400 configuration PROM (C8).

The stage-stage moves on which RLM delays are to be applied can be selected by means of configuration data (C12).

25.4.1(b) Effect On Intergreens, Holds And Demand Dependent Phases

The RLM delay time is computed and applied separately to each phase appearing within the stage. For fixed phases within the stage, the RLM delay is applied at the point when any relevant gaining delays, intergreens, SDE/SA extra clearance, and holds (i.e. extend all red) have expired and the phase is about to gain right of way. At this point, the phase is inhibited for the computed RLM delay time and then the phase starts changing to right-of-way.

For demand dependent phases gaining right-of-way when the RLF1 indication is already active, the RLM delay is applied from the point at which the phase could first appear, if it were demanded. If the RLF1 indication is not active at this point, but appears later then the RLM delay is timed from the activation of the RLF1 signal. Once the RLM delay has expired, the phase will appear as soon as its demand conditions are satisfied.

Once the RLM delay has started timing off, any hold all-red (i.e. intergreen extension) inputs are ignored.

On stage changes where a demand dependent phase could lose right-of-way, any RLM delay times on other phases due to the demand dependent phase are only applied if the demand dependent phase has actually appeared in the preceding stage.

25.4.1(c) Response Timing And Staggered Phase Starts

A vehicle red lamp fail occurring during the interstage period will be actioned, provided that the failure occurs more than 500mS before the start of the phase (i.e. changing to right-of-way, for example the start of red/amber for traffic phases).

If the red fail occurs after the start of a phase, no phase delay can be introduced on that particular phase, but other phases which have not yet appeared can still be delayed.

The above method of operation ensures that the RLM delays are introduced as soon as possible, even though this means that the appearance of some of the phases in the stage may be delayed relative to other phases which have already started.

25.4.1(d) Flashing The DFM Lamp

When all RLF1 signals are de-activated, and the manual reset is entered if ‘latching RLM’ operation is selected (C6), the DFM lamp reverts to either off or on steady, depending on whether there is a DFM fault active.

25.4.2 Operation On Second Red Lamp Fail

The operation of the controller when a second red lamp fails (RLF2 indication) can be configured for each RLM group to one of the following - see config items (C3) and (C5):-

a) For Pedestrian RLM
Inhibit selected phases - normally pedestrians - from appearing and insert permanent demands for these phases (so that wait indicators are illuminated on inhibited pedestrian phases).

If the inhibited phases are already at green, special conditioning can be used to terminate the phases on expiry of the minimum greens.

If the failure occurs while the controller is moving to a stage where an inhibited phase would appear, but the phase has not yet started to change from red, then the inhibited phase will continue to show red for the duration of the stage. On subsequent cycles, a stage which only contains inhibited phases will not be run.

NOTE: When configuring inhibits, the inhibited phases should be configured as optional within the stage.

or b) For Part-Time Signals
Set selected phases to blackout, irrespective of the current phase display (red, min green, amber etc.). Care must be taken when configuring to ensure that all phases on a stream are blacked out.

NOTE: Setting phases to blackout does not disable green correspondence checking, i.e. the greens still checked that they are off.

The second red lamp failure is actioned within 500mS of the failure occurring.

A feeder failure or a failure of the RLM unit, are actioned as for a second red lamp failure.

Where the RLF2 signal is used to blackout phases, these phases will not be allowed on again until the RLF2 signal is removed and the controller has powered off and on. This ensures that the lamps follow the required start-up sequence.

When the faulty lamps have been replaced on a part-time controller, the operator enters KRD=1 to remove the RLF2 signal, enters RFL=1 to clear the fault from the controller and then powers the controller off and on. On powering up, the lamps will come on as normal. If the faulty lamps have not been replaced then the signals are switched off again as soon as the failed aspect appears, since the integral RLM unit will detect the faulty load and re-assert RLF2.

25.4.2(a) Configuration Options

The effect of a second red lamp fail on the RLM delays can be configured (C4) for each RLM group to either:-

a) No effect, i.e. the RLM delays remain in force while RLF1 is active.

or

b) Inhibit any RLM delays due to RLF1 on this group. In this case, the RLM delays are applied only while the RLF1 indication is active and there is no second red lamp fail (RLF2 indication) on the same RLM group.

When the RLF2 indication is activated, any RLM delays already active are timed to completion but on subsequent stage changes, no RLM delays are introduced due to the RLF1 signal for that group (although the same phases may still be delayed due to the RLF1 signal on other groups).

If the RLF2 indication is removed, and the manual reset is entered if 'latching RLM' operation is selected (C6), but RLF1 is still active, then the RLM phase delays are re-introduced.

The controller can be configured (C6) for either latching RLM or non-latching RLM operation:-

a) For 'latching RLM' operation, the effect of the RLF1 or RLF2 signals is maintained until a manual reset is performed, even though the RLF1 and/or RLF2 signals are de-activated. The manual reset is detected by clearance of the RLM fault entries in the T400 fault log, i.e. lamp replacement followed by RFL=1.

or

b) For 'non-latching RLM' operation, the effect of each RLF1 or RLF2 signal is removed when the signal is de-activated, i.e. when the lamps are replaced. In the case of part-time junctions, non-latching RLF2 operation can not be achieved since the lamps were switched off when the failure was detected.

Latching of RLF1 and RLF2 can be configured separately, e.g. RFL1 non-latching and RLF2 latching.

25.4.3 Operation With Free-Standing RLM Unit

When operating with the free-standing RLM unit, the controller can be configured to provide either the original RLM facility (see the following section) or enhanced RLM operation (as described above).

If enhanced RLM operation is configured, the 'second fail pending' signal, RLF3, is not supported by the new facility and so the controller should be configured to give sufficient red time when the first fail occurs. This is to allow for the longer confirm time of the free-standing unit.

If enhanced RLM operation is configured, only the first RLM group is used.

Only the 'non-latching' mode of operation is available on the controller when using a free-standing RLM unit (latching is achieved in the free-standing RLM unit its-self).

25.4.4 Support for Original RLM Facility

The controller can be configured to select either the enhanced RLM facility or the original RLM facility (by setting or clearing the appropriate bit in the facilities table - see item C10).

If the original facility is selected, the controller will respond as for previous issues of the firmware, i.e. the intergreen hold period is timed starting from the stage change point and the hold period is configured on a stream basis.

The original RLM facility can be selected in conjunction with the integral RLM unit, so that customers can retain the original method of operation but move to the new hardware platform.

Since the original RLM facility on the controller only provided for one set of RLM inputs (RLF1, RLF2 and RLF3), only the first RLM group on the integral RLM unit would be configured.

Since the integral RLM unit has a fast response to the second red lamp fail, the RLF3 input on the controller is not required.

25.4.5 Configuration Data

(C1) RLM Delayed Phases (PROM item - RLMDFZ)

This is an 8 word array, indexed by RLM group. Each word defines the phases whose appearance is to be delayed when RLF1 is activated for that group, with one bit per phase.

Bit 15	Bit 14	...	Bit 1	Bit 0
Phase P	Phase O	...	Phase B	Phase A

0 = no phase appearance delay
1 = delay this phase appearance when RLF1 is active on this RLM group

(C2) RLM Phase Delay Times Offset (PROM item - RLMOFF)

This is a 16x16 byte array, indexed by gaining phase (minor index) and losing phase (major index). Each entry defines the phase appearance delay offset to be applied for a phase to phase move. The delay is specified in seconds, range 0 to 255 and is added to the RLM phase delay time, item C7, to give the total delay to be applied.

For any gaining phase, an offset delay is only applied if:-

a) an RLF1 signal is active
and b) the phase is selected as being delayed by that RLF1 signal (in item C2)
and c) a phase delay applies to this stage-stage movement, i.e. at least one of the losing phases on this stage-stage movement has a non-zero RLM delay for this gaining phase
and d) RLM delays are enabled on this stage-stage move (see LMUMOV item C12).

Where there is more than one applicable phase delay, the longest one is used.

(C3) RLM Phase Inhibits (PROM item - RLMIFZ)

This is an 8 word array, indexed by RLM group. Each word defines the phases whose appearance is to be inhibited when RLF2 is activated for that group, with one bit per phase.

Bit 15	Bit 14	...	Bit 1	Bit 0
Phase P	Phase O	...	Phase B	Phase A

0 = phase appears as normal
1 = inhibit this phase appearance when RLF2 is active on this RLM group

NOTE: Inhibited phases display either red or blackout - see (C5).

(C4) RLF2 Cancel Option (PROM item - RLF2_CANCEL_RLF1)

This byte contains one bit for each RLM group:-

Bit 7	Bit 6	...	Bit 1	Bit 0
Group 7	Group 6	...	Group 1	Group 0

0 = RLF2 has no effect on RLF1.
1 = When RLF2 is activated, any phase appearance delays due to RLF1 on this RLM group are cancelled.

(C5) Switch off/inhibit Option (PROM item - RLF2_SWITCH_OFF)

This byte contains one bit for each RLM group:-

Bit 7	Bit 6	...	Bit 1	Bit 0
Group 7	Group 6	...	Group 1	Group 0

0 = When phases are inhibited by RLF2, the phases display red.
1 = When phases are inhibited by RLF2, the phases are switched off (i.e. blackout). This option is used for part-time signals and care must be taken when configuring to ensure that all phases on a stream are blacked out.

(C6) RLM Latching Option (PROM item - LATCHED_RLMS)

This word contains two bits for each RLM group and each bit pair selects latching or non-latching operation for RLF1 and RLF2:-

...	Bit 3	Bit 2	Bit 1	Bit 0
...	Group 1 RLF2	Group 1 RLF1	Group 0 RLF2	Group 0 RLF1

'Even' bits: 0 = The effect of RLF1 is removed when the faulty lamp is replaced.
1 = A manual reset is required to clear RLF1.

'Odd' bits: 0 = The effect of RLF2 is removed when the faulty lamps are replaced (assuming the signals have not been switched off).
1 = A manual reset is required to clear RLF2.

Note that for a part-time controller, RLF2 should be configured as non-latching as the latching effect is achieved in the RLM unit since the lamps are switched off.

(C7) RLM Phase Delay Times (PROM item - RLMBUV & RAM item - RLMTME)

This 16 byte array contains the RLM delay time, in seconds, for each phase. The delay is alterable via the handset, and is in addition to any delay specified in the RLM delay offset, item C2. The handset range is configurable via item C8.

The delay time is only applied if RLM delays are enabled on this stage-stage move (see LMUMOV item C12).

(C8) RLM Delay Limits (PROM item - RLMTMERNG)

This word holds the low and high range limit on the RLM delay times, used to check that new times entered from the handset are within the allowed limits. The least significant byte of the word holds the high limit and the most significant byte of the word holds the low limit. If the low limit is set above the high limit then this stops the configured RLM delay times being changed via the handset.

(C9) Number of Integral RLM Groups (PROM item - INTRLM_GROUPS_CFG)

This byte holds the number of integral RLM groups configured. The value should be set to 0 when the free-standing RLM unit is used. When the integral RLM unit is used, the value should be set in the range 1 to 8 as appropriate.

(C10) Enhanced RLM Facilities Table Bit (PROM item - ENHANCED_RLM)

The enhanced RLM facility is disabled unless bit 0 of this byte is set in the facilities table.
When the facilities table bit is not set, the T400 operates to the original RLM method. In this case, RLF1 and RLF2 can still be configured to come from the integral RLM unit if required.

(C11) Integral RLM Facilities Table Bit (PROM item - OTUFAC)

Bit 1 of OTUFAC in the facilities table selects between the free-standing RLM unit and the integral RLM unit. When the bit is a zero, the free-standing unit is assumed and the config items LMU1ST and LMU2ND should be set to the RLF1 and RLF2 input lines. When the bit is a one, the integral unit is assumed and the RLF1 and RLF2 signals are taken from the integral RLM shared RAM. In this case, item C9 should be set to the number of RLM groups configured.

Note: Bit 0 of OTUFAC indicates if an integral OTU/LMU is fitted. For integral RLM, both bit 0 and bit 1 of OTUFAC should be set.

(C12) LMU Moves Array (PROM item - LMUMOV)

This is an existing config PROM item which is used by both the original RLM facility and enhanced RLM operation. It comprises a 16 word array and defines for each stage to stage move whether the RLM delays are to be applied or not.

25.4.6 Configuration Considerations

25.4.6(a) All-red Stages

When stage to stage moves are made via an intermediate all-red stage, the RLM phase offset delays will only be applied on the basis of the phase changes involved on the move from the all-red stage to the target stage.

The all-red stage should include a dummy phase and then any required RLM delay time offsets should be configured on changes between the dummy phase and the phases appearing in the target stage.

25.4.6(b) Intermediate Stages

When stage to stage moves are made via an intermediate stage, the same considerations apply as for the all-red stage. If no phases (either real phases or dummy phases) are losing right-of-way on the change from the intermediate stage to the target stage, then no RLM offset delays will be applied. To avoid this, a dummy phase should be configured in the intermediate stage.

APPENDIX A) SUPPLYING DC POWER FOR VEHICLE DETECTORS

Table APPENDIX A) -1 gives the total number of 24 volt above-ground detectors or detector cards (2-channel and 4-channel) which can be driven from the internal 24v power supply. This is qualified by the number of Expansion I/O cards and SDE/SA cards which are also being supplied from the same Power Supply.

Table APPENDIX A) -2 to Table APPENDIX A) -5 show the distances at which different numbers of detectors can be supplied by the 24V supply. The actual distance is determined by the voltage drop along the detector supply cable.

Table APPENDIX A) -6 to Table APPENDIX A) -8 show the maximum number of detectors that can be supported by both the small and large 27.5V Detector PSU.

Table APPENDIX A) -9 to Table APPENDIX A) -12 show the distances at which different numbers of detectors can be supplied by the 27.5V supply. The actual distance is determined by the voltage drop along the detector supply cable.

Table APPENDIX A) -13 and Table APPENDIX A) -14 cover SDE for Siemens/Microsense and Sarasota systems.

Note that detectors should never be powered from a regulator when used with the T400.

Power for ‘D’ Detectors can be obtained by fitting a 45v/0.5 Ampere unregulated supply in the T400. See also Section 18.12. Maximum distances are given in Table APPENDIX A) -15.

Appendix APPENDIX A) .1) Using 24v 2A Internal Supply for Detectors

There is spare capacity on the 24v power supply. The exact amount depends upon the number of Expansion I/O Boards and their equivalents (1 SDE/SA Board @ 250mA is equivalent to two Expansion I/O Boards @ 2 x 125mA). e.g. 5 equivalents represent 3 Exp I/O + 1 SDE/SA.

The use of the internal 24v power supply is also dependent upon the distance rules see the following section.

Table APPENDIX A) -1) Using the 24v 2A Internal Supply For Detectors

The following table indicates the maximum number of detector cards the T400 is capable of supporting on the 24v 2A internal supply, given the number of expansion I/O boards fitted (or equivalent) and the type of detector card:-

Expansion I/O Equivalents	0	1	2	3	4	5
Siemens and Microsense 2- and 4-Channel (220mA)	8	8	7	6	6	5
Sarasota 4-Channel MCE28Z (370mA)	5	4	4	4	3	3
Sarasota 4/2/1-Channel MTS38Z/36Z/35Z (160mA)	11	11	10	10	8	8
24v ±20% 8VA Above Ground Detectors (333mA)	5	5	4	3	3	3

i.e. The controller is capable of supporting at least 5 Siemens detector cards (subject to distance) even when fully equipped.

Appendix APPENDIX A) .2) Using 24v 2A Internal Supply - Cable limitations

Table APPENDIX A) -2 to Table APPENDIX A) -5 indicate the permissible cable lengths and whether 2 parallel cores are required for various detectors.

S = Single conductor out and return
P = Parallel conductors out and return

Assumes 1mm^2 cable.

(distances quoted are the 'Maximum distance from the controller')

Table APPENDIX A) -2) Number of Detector Boards (Siemens & Microsense) in External Housing(s) Using a Common Cable (220mA per card)

Beehives:	1		2		3		4		5		6	
Detectors:	1	2	3	4	5	6	7	8	9	10	11	12
100m	S	S	S	S	P	P	P	P				
125m	S	S	S	P	P	P						
150m	S	S	P	P	P							
175m	S	S	P	P								
200m	S	S	P	P								
225m	S	S	P									
250m	S	P	P									

Table APPENDIX A) -3) Number of Detector Boards (Sarasota MCE28Z) in External Housing(s) Using a Common Cable (370mA per card)

Beehives:	1		2		3		4		5		6	
Detectors:	1	2	3	4	5	6	7	8	9	10	11	12
100m	S	P										
125m	P											
150m	P											
175m	P											
200m	P											
225m	P											
250m												

Table APPENDIX A) -4) Number of Detector Boards (Sarasota MTS38Z/36Z/35Z) in External Housing(s) Using a Common Cable (160mA per card)

Beehives:	1		2		3		4		5		6	
Detectors:	1	2	3	4	5	6	7	8	9	10	11	12
100m	S	P										
125m	S	P										
150m	P											
175m	P											
200m	P											
225m	P											
250m												

Table APPENDIX A) -5) Number of 24v +/-20% 8VA (333mA) Above Ground Detectors Using a Common Cable

	Number of detectors on one cable run				
Max cable run from controller	1	2	3	4	5
25m	S	S	S	S	S
50m	S	S	S	P	P
75m	S	S	P	P	P
100m	S	P	P		
125m	S	P	P		
150m	S	P			
175m	S	P			
200m	P	P			

Appendix APPENDIX A) .3) Using 27.5v Additional Detector PSU

Where there is insufficient spare capacity on the 24v power supply the 27.5v supply must be called up. (Table APPENDIX A) -6 to Table APPENDIX A) -8)

The distance rules are different for this supply as the allowable voltage drop is greater due to the higher supply voltage;- see Table APPENDIX A) -9 to Table APPENDIX A) -12.

Table APPENDIX A) -6) 4-Channel Detector Cards

	Maximum No. of 4-Channel Cards		
	Siemens or Microsense (220mA)	Sarasota	
		(370mA)	(160mA)
Small PSU 667/7/20204/001 (2A)	7	4	9
Large PSU 667/7/20204/000 (4A)	13	8	18

Table APPENDIX A) -7) 2-Channel Detector Cards

	Maximum No. of 2-Channel Cards		
	Siemens or Microsense (220mA)	Sarasota	
		(370mA)	(160mA)
Small PSU 667/7/20204/001 (2A)	7	6	9
Large PSU 667/7/20204/000 (4A)	15	13	18

Note:
2 Channel Detector cards are usually used for SDE/SA
see Manufacturers information.

Table APPENDIX A) -8) 24v +/-20% 8VA (333mA) Above Ground Detectors

	Max. No. of Detectors
Small PSU 667/7/20204/001 (2A)	6
Large PSU 667/7/20204/000 (4A)	12

Appendix APPENDIX A) .4) Using 27.5v Detector Supply - Cable Limitations

Table APPENDIX A) -9 to Table APPENDIX A) -12 indicate the permissible cable lengths and whether 2 parallel cores are required for various detectors.

S = Single conductor out and return
P = Parallel conductors out and return

Assumes 1mm^2 cable.

NB: The following tables for distances assume the use of 1mm^2 cable with the detector current specified. Use of larger cable will increase the length of run possible as will use of detectors with a lower operating current. Recalculate any values as required on a pro-rata basis.

The distances quoted are the 'Maximum distance from the controller'.

Table APPENDIX A) -9) Number of Detector Boards (Siemens & Microsense) in External Housing(s) Using a Common Cable (220mA per card)

Beehives:	1		2		3		4		5		6	
Detectors:	1	2	3	4	5	6	7	8	9	10	11	12
100m	S	S	S	S	S	S	S	S	P	P	P	
125m	S	S	S	S	S	S	S	P	P	P	P	
150m	S	S	S	S	S	S	P	P	P	P	P	
175m	S	S	S	S	S	P	P	P	P	P		
200m	S	S	S	S	P	P	P	P	P			
225m	S	S	S	S	P	P	P	P				
250m	S	S	S	P	P	P	P					

Table APPENDIX A) -10) Number of Detector Boards (Sarasota) in External Housing(s) Using a Common Cable (370mA per card)

Beehives:	1		2		3		4		5		6	
Detectors:	1	2	3	4	5	6	7	8	9	10	11	12
100m	S	S	S	S	P	P	P	P				
125m	S	S	S	P	P	P						
150m	S	S	P	P	P							
175m	S	S	P	P								
200m	S	S	P	P								
225m	S	P	P									
250m	S	P	P									

Table APPENDIX A) -11) Number of Detector Boards (Sarasota) in External Housing(s) Using a Common Cable (160mA per card)

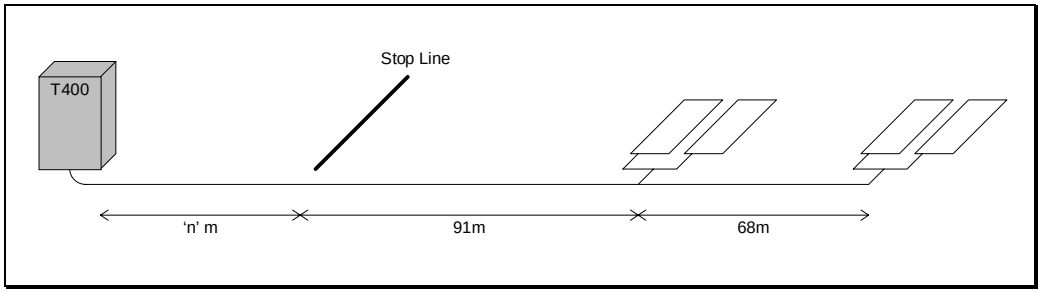
Beehives:	1		2		3		4		5		6	
Detectors:	1	2	3	4	5	6	7	8	9	10	11	12
100m	S	S	S	S	P	P	P	P				
125m	S	S	S	P	P	P	P					
150m	S	S	S	P	P	P						
175m	S	S	P	P	P							
200m	S	S	P	P								
225m	S	S	P									
250m	S	P	P									

Table APPENDIX A) -12) Number of 24v +/-20% 8VA (333mA) Above Ground Detectors Using A Common Cable

	Number of detectors on one cable run							
Max cable run from controller	1	2	3	4	5	6	7	8
25m	S	S	S	S	S	S	S	S
50m	S	S	S	S	S	S	S	S
75m	S	S	S	S	S	S	S	P
100m	S	S	S	S	S	P	P	P
125m	S	S	S	S	P	P	P	P
150m	S	S	S	P	P	P	P	
175m	S	S	S	P	P	P		
200m	P	P	P					

Appendix APPENDIX A) .5) Cable Distances for SDE

NOTE: SDE/SA cabling assumes the use of 2 Channel Detectors, some 4 Channel Detectors can be used for SDE/SA. See Manufacturer's information.



NB: The following tables for distances assume the use of 1mm^2 cable with the detector current specified. Use of larger cable will increase the length of run possible as will use of detectors with a lower operating current. Recalculate any values as required on a pro-rata basis.

Table APPENDIX A) -13) Cable Distances for SDE using Siemens or Microsense Detectors

Cable length from stop line to controller = 'n' metres
Cable 1mm^2 = 0.0362 Ohm/metre loop
Supply Voltage for Detectors = 19.2V - 28.8V
Detector PSU Output Voltage = 27.5V±4.5% (Max 28.74V, Min 26.26V)
Max permissible volt drop (27.5V PSU) = 7.06V.
Logic PSU = 24v±6% (Max 25.44V, Min 22.56V)
Max permissible volt drop (24V supply) = 3.36V.

	Cable Length 'n'	
Power supply:	27.5v P.S.U.	24v P.S.U.
3-lane 1 conductor out & return	37.5 metres	UNUSABLE
3-lane 2 conductors out & return	200 metres	29.7 metres
2-lane 1 conductor out & return	48.8 metres	UNUSABLE
2-lane 2 conductors out & return	362 metres	107 metres
1-lane 1 conductor out & return	362 metres	107 metres
1-lane 2 conductors out & return	850 metres	339 metres

Table APPENDIX A) -14) Cable Distances for SDE using Sarasota Detectors (2 CHANNEL)

Cable length from stop line to controller = 'n' metres
Cable 1mm^2 = 0.0362 Ohm/metre loop
Supply Voltage for Detectors = 21V - 40V
Detector PSU Output Voltage = 27.5V±4.5% (Max 28.74V, Min 26.26V)
Max permissible volt drop (27.5V PSU) = 5.26V
Logic PSU = 24v±6% (Max 25.44V, Min 22.56V)
Max permissible volt drop (24V supply) = 1.56V

	Cable Length 'n'			
power supply:	27.5v P.S.U.		24v P.S.U.	
current per 2 channel card:	230mA	160mA	230mA	160mA
3-lane 1 conductor out & return	unusable	24	unusable	unusable
3-lane 2 conductors out & return	85	177	unusable	unusable
2-lane 1 conductor out & return	32	41	unusable	unusable
2-lane 2 conductors out & return	147	329	unusable	9
1-lane 1 conductor out & return	190	329	unusable	9
1-lane 2 conductors out & return	506	780	62	144

Table APPENDIX A) -15) Maximum Distances for feeder cable when using 'D' Detectors

Load Calculation

Maximum O/P current	=	500 milliamps
Current per Regulator board	=	16 milliamps (1 regulator per beehive)
Current per detector board	=	48 milliamps
Minimum input voltage to regulator	=	32v
Minimum power supply output voltage	=	35.4v

Maximum number of cards driven

Assuming two beehives the maximum number of cards that can be driven from the Power Supply is **nine.**

Maximum feeder length (9 Cards)

Using the same figures for cable resistance as previously (0.0362 Ohms/metre loop) and assuming the maximum number of cards then:

Maximum feeder length is approximately 200 metres.

Using the above figures the length can be calculated for any number of detectors if required.

SDE/SA Detection

Using Triple SDE on two lanes (8 cards)

The Controller must be within 70 metres of the stop line.

APPENDIX B) 50-0-50 Volt Controller

B.1 50-0-50 volt Controller

Note: This version of the T400 does not meet DTp specification MCE0141 in respect of dimming voltages and voltage sensing. This is inherent in the 50-0-50 volt output but it meets the equivalent figures which are multiplied by (50+50)/240.

The 50-0-50 volt controller is a version of the standard so that the voltages on the cables leaving the controller are 50 volts A.C. nominal with respect to earth, rather than the standard 240 volts, and are transformer isolated from the incoming mains supply.

The voltage on feeds to signals and to auxiliary devices such as regulatory signs, microwave detectors solar cells etc. is nominally 50-0-50 volt rms (50 Hz) with the centre tap taken to earth. This requires all street furniture to be modified to enable operation at these voltages. Low voltage dc supplies for detectors (nominal 24 volts) are unaffected.

An additional circuit breaker can be provided to enable the 50-0-50 volt feeds to be isolated with a single switch without switching the controller logic off. (This does not include the 24 volts intended for supplying external loop detectors.)

For controller operation at 50-0-50 volt all street furniture must be modified using the appropriate kits and additional hardware is required in the controller.

B.2 Dual Solar Cell (Only Available on 50-0-50 Volt Controller)

The solar cell facility can be modified to enable two solar cell outputs to be monitored. The solar cell outputs are connected via two relays to two controller inputs. One of the solar cells will then cause the controller to change between dim and bright in the normal manner. The part number for the dual solar cell kit is 667/1/21020/000.

The two solar cell outputs are monitored and when either of the following two fault conditions occur the signals will be set to the non-dimmed state.

1. If both solar cells outputs remain in the same state for more than 16 hours. This is adjustable in the range of 0 to 255 hours using handset command PIR0. The value which is assigned to handset command PIR0 will give required monitor time in hours, with the default setting being 16.

2. If the solar cell outputs are in different states for more than 45 minutes. This is adjustable in the range of 0 to 255 minutes using handset command PIR1. The value which is assigned to handset command PIR1 will give required monitor time in minutes, with the default setting being 45.

When either of the above two faults occur the controller fault log 27 will be set as shown below. The fault log will remain set until reset using the handset. While the fault log is active the signals will be held in the non-dimmed state.

FLF 27 = 1 If the solar cell outputs remain in the same state for more than 16 hours.

FLF 27 = 2 If the solar cell outputs are in different states for more than 45 minutes.

FLF 27 = 3 If both the above two conditions occur.

Additional hardware and configuration information is required to enable this facility.